JULIUS A. PALMER,

SCIENTIFIC TRACTS,

DESIGNED FOR

INSTRUCTION AND ENTERTAINMENT,

AND ADAPTED TO

SCHOOLS, LYCEUMS, AND FAMILIES.

CONDUCTED BY

JOSIAH HOLBROOK AND OTHERS.

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SCIENTIFIC TRACTS.

VOL. II......NO. I.

POPULAR SUPERSTITIONS.

There are few persons, who will *acknowledge* that they are superstitious; but there are still less, who are not in some degree, under the influence of superstitious fears. There is almost a universal apprehension of something supernatural. Those who laugh the loudest at ghosts, and hobgoblins, will still quicken their pace, as they hear some unusual sound when passing the graveyard at the gloomy hour of midnight. The calm and intellectual philosopher, whose reason spurns all imaginary evils, is compelled at times to be ashamed of himself, as he finds that imagination has the mastery over judgment. The reason of the universal prevalence of these feelings is to be found in a great degree, in the impressions we receive in childhood. The tales of the nursery awaken a belief, which the future judgment may pronounce to be foolish, but the influence of which, in a greater or less degree, is felt through life. There is undoubtedly much in the peculiarity of our present condition, to give the mind a strong tendency to apprehend supernatural events. The mysterious union of soul to body; the awful phenomenon of death — the departure of friends we love, from present scenes, and their entrance upon a condition we know not what, and into worlds we know not where — the certain knowledge of spiritual existences unseen and unheard, all prepare the mind to be easily excited by occurrences, apparently conflicting with acknowledged laws. But it is generally in childhood that we receive those impressions, which future years are unable to erase.

And lest any, from the selection of this subject should anticipate a *mirth making* performance, we forewarn our readers that it will not be our endeavor to amuse with witty speculations but to interest with facts.

It is a fact, humiliating though it be, that there is hardly an individual in any land who does not at times experience momentary inconveniences from such feelings. And there are great multitudes who have an undoubting confidence in the reality of ghostly interference in mortal concerns.

Those who are not habituated to reflection, often retain undiminished till a dying hour, a belief in those signs and omens which they were taught in childhood. They do not question the truth of those ideas, which have been instilled into the mind in earliest infancy, and which have been the motives to which parents have first appealed, in imbecile efforts to govern. How often is a child told that unless he ceases crying, he shall be shut up in a dark closet, where the ghosts will come and get him. And what an indelible impression must such a threat produce upon the pliant mind. With the unreflecting, superstition is consequently strong. Their minds are not sufficiently cultivated to throw off the load which has been imposed upon them. The better informed, who are accustomed to examine their feelings, and inquire into the grounds of their belief, emancipate their judgments from these unreal fears, but are generally through life in some degree under the control of the strong prejudices, which were early inculcated. The belief in supernatural appearances is so general, and is productive of such evil consequences, that the subject deserves a sober treatise.

1. We shall first allude to those appearances which are unusual, and which to the uninformed seem supernatural, but which are capable of explanation from the known principles of philosophy or natural science. The fire balls, usually known by the name of 'Jack with the Lantern,' or 'Will o' the Wisp,' so often seen dancing over the marsh, produce great terror and often serious injury. Now here there is no delusion. A person actually sees a light where there is no human being

who bears it, and not being acquainted with the chemical principles of inflammable gases, and spontaneous combustion, he naturally concludes, that it must be some apparition sent as a warning to himself, or to the village. Perhaps in a few days some accident occurs, or some neighbor dies, and he feels without a doubt, that this luminous meteor was sent as a monition. This story is circulated through the whole village. As it passes from house to house, it is receiving constant accessions, and grows more marvellous and more appalling, till every child is afraid to venture out of doors, after nightfall. The man who is conversant with natural science, beholds in this appearance no cause of fear, but an interesting natural phenomenon. An inflammable gas oozes from the ground, and is set on fire by spontaneous combustion. A person who is acquainted with gases, can take a tumbler and go to the marsh and fill it with this gas, and returning to his house burn it there. But how is it set on fire, down in the marsh, where everything is damp? It is well known that barns are frequently burnt in consequence of hay being put into them before it has been sufficiently dried. The damp hay inflames itself. In the same manner this gas, which is so very combustible, may be set on fire, and the innocent flickering of its feeble flame, sends dismay through an ignorant and superstitious village.

Every boy is acquainted with lightwood, and yet many a man has fled as though demons were in pursuit of him, because he has seen in some rotten stump the bright light which decayed wood emits. His terrified imagination, aided by the darkness of the night, transforms the stump into a giant with eyes of fire and tongue of flame, and remembering that the 'better part of courage is discretion,' he seeks safety in flight. When he arrives at his home breathless, and pale, and trembling, to satisfy his affrighted hearers that he had good cause for his terror, he declares that the giant called after him and pursued him, and that he heard the loud clatter of the monster's feet close behind him. The children creep off trembling to bed, and dream all night of ghosts, and never forget the occurrence till their dying hour. The poor

stump remains in the field perfectly unconscious of the injury it has done. The light in this decayed wood is produced by a substance called phosphorus. It is this which God has given, as a lamp to the firefly. This substance, chymists can collect in large quantities. The light which it emits is so pale, that it cannot be seen in the day, but is easily discernible in the night. A person with a stick of phosphorus once wrote upon the wall of another's bed-chamber, '*This night thou must die.*' When the person entered his bed-chamber the light of the lamp prevented his observing the light of the phosphorus; but as soon as the lamp was extinguished, he beheld the warning words glaring from the wall. But he happened to be acquainted with the nature of phosphorus, laughed heartily at the attempted deception, and quietly fell asleep. The experiment, however, was hazardous and wicked, for an ignorant person, and one of sensitive nerves, might thus have received an irrecoverable shock.

The following account of a case of unnecessary alarm is given by Scott. The agency of philosophical principles was employed in the deception. 'At a certain old castle, on the confines of Hungary, the lord to whom it had belonged, had determined upon giving an entertainment, worthy of his own rank, and of the magnificence of the antique mansion which he inhabited. The guests of course, were numerous, and among them was a veteran officer of hussars remarkable for his bravery. When the arrangements for the night were made, this officer was informed there would be difficulty in accommodating the company in the castle, large as it was, unless some one would take the risk of sleeping in a room supposed to be haunted; and that as he was known to be above such prejudices, the apartment was in the first place proposed for his occupation, as the person least likely to suffer a bad night's rest from this cause. The major thankfully accepted the preference, and having shared the festivity of the evening, retired after midnight, having denounced vengeance against any one who should by any trick attempt to disturb his repose. A threat which his habits would, it was supposed, render

him sufficiently ready to execute. Somewhat contrary to the custom in these cases, the major went to bed, having left his candle burning, and laid his trusty pistols carefully loaded upon his bedside.

'He had not slept an hour, when he was awakened by a solemn strain of music. He looked out. Three ladies fantastically dressed in green, were seen at the lower end of the apartment, who sung a solemn requiem. The major listened some time with delight. At last he grew tired. "Ladies," said he, "this is very well, but somewhat monotonous, will you be so kind as to change the tune." The ladies continued singing. He expostulated, but the music was not interrupted. The major began to grow angry. "Ladies," he said, "I must consider this a trick, for the purpose of terrifying me, and as I regard it as an impertinence, I shall take a rough mode of stopping it." With that he began to handle his pistols. The ladies sung on. He then got seriously angry. "I will wait but five minutes," he said, "and then fire without hesitation." The song was still uninterrupted, — the five minutes were expired. "I still give you leave, ladies," he said, "while I count twenty." This produced as little effect as his former threats. He counted, one — two — three — accordingly, but on approaching the end of the number, and repeating more than once his determination to fire — the last numbers, seventeen — eighteen — nineteen — were pronounced with considerable pauses between, and an assurance that the pistols were cocked. The ladies sung on. As he pronounced the word twenty, he fired both pistols against the musical damsels — but the ladies sung on. The major was overcome by the unexpected inefficacy of his violence, and had an illness which lasted more than three weeks. The trick put upon him, may shortly be described by the fact, that the female choristers were placed in an adjoining room — and that he only fired at their reflection, thrown forward into that in which he slept, by the effect of a concave mirror.'

Here the plain and well known laws of the reflection of light, accounts for the whole appearance. But, suppose the deception had never been explained, what reasoning could ever have satisfied the man, that the

room was not in reality haunted. It would have been one of the most conclusive ghost stories, that ever was heard. Had he rose from the bed to investigate, the ladies would merely have withdrawn from before the mirror, and the apparition would have vanished; and by again resuming their place, as he laid down, the vision would again have appeared before him.

The writer once knew a young man, who in sultry summer nights, rose from his bed to walk his chamber. As he rose he observed distinctly a man on the opposite side of the room. He was much alarmed and stood still for a moment, looking at the man, and then softly slipped down behind the bed to watch his movements. As he stooped, the man stooped; when suddenly the young gentleman burst into a laugh, to find that he was watching his own reflection in the looking-glass. A person of feebler courage, or of nervous excitability, would have screamed 'a ghost,' and would have forever declared that he could not discredit the evidence of his own senses.

We will mention another circumstance to show how easily a person may be deceived, by an occurrence, which is capable of a perfectly natural explanation. An aged lady had long been sick, and was near her death. One afternoon, as she was sitting in her room with a young lady, a friend who was her constant attendant, the whole room seemed suddenly illuminated. The room faced the east. The sun was far down in the west, and could not shine into it. 'What is that?' said the aged lady. They both looked, and beheld the strange light glittering upon the wall. Three successive times the mysterious illumination appeared and vanished. A few moments after, some one of the family entering the room, the aged lady remarked, 'I have just had a warning, which tells me that I am very near my end — a truth which certainly did not need any supernatural attestation.' Had the sick lady seen the vision alone, there would have been no difficulty in attributing it to a disordered imagination. But the young lady beheld it also, and she was one not easily alarmed. There was no way in which the occurrence could be explained, and there it rested. The aged lady felt perfectly satisfied, tha she had been warned to pre-

pare for death, and she made her preparation accordingly, and in a week or two died. She left the world entirely convinced that she had witnessed a supernatural vision. You might as well have attempted to reason her out of the belief of her own consciousness, as to have reasoned away the reality of this apparition. A week or two after her death, the writer called at a house where some college students roomed, and found them amusing themselves, by casting reflections with a large looking-glass into the houses of the village. In an instant, the whole mystery of the apparition was explained. These young men had thrown a reflection three times into the room, and thus had given it apparently a supernatural illumination.

Any one who is acquainted with the wonderful powers of ventriloquism, knows that a person may abuse that power, to the very serious annoyance of those who are easily alarmed. A ventriloquist can, without difficulty, cause unearthly sounds, groanings, knockings, &c, to be heard in different parts of the house, and he can be all the time moving about with the family, an unsuspected spectator. Many a house has been thus haunted, to the extreme terror of its occupants, and to the great mirth of the mischievous joker.

These principles will account for a vast number of those appearances, which seem to be supernatural. The man who is unacquainted with these laws, thinks at once, and very naturally, that there must be ghostly agency in the production of effects, which to him are so unaccountable, and he is, therefore, too much alarmed to give the subject a cool investigation.

We have, somewhere, met with another account illustrative of the same principle. A ship was lying becalmed, one warm summer afternoon, in the middle of the Atlantic. The atmosphere was clear, and the sky serene, with the exception of a few clouds floating in their fleecy whiteness. As the officers of the ship were carelessly reclining upon the quarter deck, and the sailors lolling in the listlessness of a calm at sea, whistling for the wind, all were surprised by seeing, far off in the horizon, where the sky and the water seemed to meet, a ship under full

canvas, sailing along in the sky. The ship was upside down, the masts pointing towards the water. The vision was so distinct, that all perceived it, and marked the peculiarities of her rigging. For some considerable time she continued in view, attracting the gaze of the whole ship's company, till finally she vanished. The sailors with their customary superstition, were exceedingly alarmed. This was to them a new kind of navigation. They deemed it the certain foreboding of their own destruction. The officers, better informed with regard to the laws of nature, saw in the occurrence, a very surprising, and very interesting natural phenomenon. By the peculiar state of the air and the situation of the clouds, a mirror was formed, in which by the natural operation of reflected light, they saw the image of a ship, which had not as yet ascended the horizon. There are various kinds of mirrors. Sometimes they are made of glass, sometimes of burnished steel. The water is a mirror in which you see the trees which wave luxuriantly upon the river's banks, and from the vapors which float in the heavens, as from a looking glass, images are often reflected. In a few hours after the appearance of the vision, the identical ship herself made her appearance, rising over the convex waters. This was the ghost of a ship, and the tale has probably been narrated, with exaggerations of terror, to thousands of seamen.

Another case, somewhat similar, we somewhere have met with, though we cannot now recollect in what work, which shows how incidents, at first apparently supernatural, may be explained by known principles. On a calm day, the sailors on board a ship, many hundred miles from land, and with no other sail in sight, had their attention arrested by the distinct ringing of a bell. They ascended the topmast, but far as the eye could extend along the unobstructed horizon, nothing could be seen. From whence could this sound proceed? No bell by the common conveyance of sound, could be heard the distance that they could see. To the sailors, this apparently unearthly ringing, seemed to be the ship's funeral knell. The mournful monotony of those mysterious tones, sent paleness into the cheek of many a hardy tar.

And surely, it was strange to hear such a sound in the solitude of the ocean. They thought it must come from the world of spirits, a monition of their ruin. Scientific men on board accounted for it at once, upon the well understood principle of an acoustic tube. As the report of a gun discharged upon some Alpine summit, is thrown in thundering reverberations from cliff to cliff, so in the present case, the clouds reflected the sound of the bell, of a distant ship into the focus, in which they were placed. In the tongueless voices of every echo, there is just as much of a supernatural agency. The next day they met the ship, whose bell they had heard, and found by inquiry, that at the hour they heard the sound, the crew had been violently ringing for their amusement. How many of the apparently unnatural sounds which are heard, are capable of an equally simple explanation.

2. We hear of many extraordinary appearances, which cannot be accounted for from any known laws of *matter*, but which may be easily explained from the known principles of the *mind*. The wonderful power which imagination has to transform ordinary things, and to call into existence, things which are not, is fully known. A man who is thoroughly frightened, can imagine almost anything. The whistling of the wind, sounds in his ears like the cry of dying men. As he walks along trembling in the dark, the friendly guide-post is a giant; the tree gently waving in the wind is a ghost; and every cow he chances to meet is some fearful apparition from the land of hobgoblins. Who is there that cannot testify from personal experience, of some such freaks of imagination. How often does one wake up in the night and find the clothes upon the chair, or some article of furniture in the room, assuming a distinctly defined form, altogether different from that which it in reality possesses.

There is in imagination, a potency far exceeding the fabled power of Aladdin's lamp. How often does one sit in wintry evening musings, and trace in the glowing embers, the features of an absent friend. Imagination with its magic wand, will there build the city with its countless spires — or marshal contending armies — or drive the tempest shattered ship upon the ocean. The

following story related by Scott, affords a good illustration of this principle.

'Not long after the death of a late illustrious poet, who had filled while living, a great station in the eye of the public, a literary friend, to whom the deceased had been well known, was engaged during the darkening twilight of an autumn evening, in perusing one of the publications, which professed to detail the habits and opinions of the distinguished individual, who was now no more. As the reader had enjoyed the intimacy of the deceased to a considerable degree, he was deeply interested in the publication, which contained some particulars relating to himself and other friends. A visitor was sitting in the apartment, who was also engaged in reading. Their sitting room opened into an entrance hall rather fantastically fitted up with articles of armor, skins of wild animals and the like. It was when laying down his book and passing into this hall, through which the moon was beginning to shine, that the individual of whom I speak, saw right before him, in a standing posture, the exact representation of his departed friend, whose recollection had been so strongly brought to his imagination. He stopped for a single moment, so as to notice the wonderful accuracy with which fancy had impressed upon the bodily eye, the péculiarities of dress, and position of the illustrious poet. Sensible, however, of the delusion, he felt no sentiment, save that of wonder, at the extraordinary accuracy of the resemblance, and stepped onward towards the figure, which resolved itself as he approached into the various materials of which it was composed. These were merély a screen occupied by great coats, shawls, plaids, and such other articles as are usually found in a country entrance hall. The spectator returned to the spot from which he had seen the illusion, and endeavored with all his power, to recall the image which had been so singularly vivid. But this was beyond his power. And the person who had witnessed the apparition, or more properly, whose excited state had been the means of raising it, had only to return into the apartment, and tell his young friend, under what a striking hallucination, he had for a moment labored.'

Most persons under such circumstances, would have declared unhesitatingly, that the ghost of the departed had appeared to them, and they would have found great multitudes who would have believed it. When the imagination has such power to recall the images of the absent, is it at all wonderful that many persons should attribute such appearances to supernatural visitations. Had the poet himself been in the place of the screen, he probably would not have been more vividly present. How many then of the causes of vulgar fear are to be attributed to the effect of imagination. A lady was once passing through a wood, in the darkening twilight of a stormy evening, to visit a friend, who was watching over a dying child. The clouds were thick — the rain beginning to fall — darkness was increasing — the wind was moaning mournfully through the trees. The lady's heart almost failed her as she saw that she had a mile to walk through the woods, in the gathering gloom. But the reflection of the situation of her friend forbade her turning back. Excited and trembling, she called to her aid a nervous resolution, and pressed onward. She had not proceeded far, when she beheld in the path before her the movement of some very indistinct object. It appeared to keep a little distance in advance of her, and as she made efforts to get nearer, to see what it was, it seemed proportionably to recede. The lady began to feel rather unpleasantly. There was some pale white object, certainly discernible before her, and it appeared mysteriously to float along at a regular distance, without any effort at motion. Notwithstanding the lady's good sense and unusual resolution, a cold chill began to come over her. She made every effort to resist her fears, and soon succeeded in drawing nearer the mysterious object, when she was appalled at beholding the features of her friend's child — cold in death — wrapped in its shroud. She gazed earnestly, and there it remained distinct and clear before her eyes. She considered it a monition, that her friend's child was dead, and that she must hasten on to her aid. But there was the apparition directly in her path. She must pass it. Taking up a little stick she forced herself along to the object, and behold some

little animal scampered away. It was this that her excited imagination had transformed into the corpse of an infant, in its winding sheet. The vision before her eyes was undoubtedly as clear, as the reality could have been. Such is the power of imagination. If this lady, when she saw the corpse, had turned in terror, and fled home, what reasoning could ever have satisfied her, that she had not seen something supernatural! When it is known that the imagination has such a power as this, can we longer wonder at any accounts which are of unearthly appearances?

When a man is terrified he is always disposed to exaggerate. And if one has been frightened by some trifle, to save himself from exposure to ridicule, he magnifies the trifle into something truly appalling, hoping thus to save his reputation. Though a man may not mean actually to tell a lie, the temptation to exaggerate under such circumstances is too great to be withstood. This principle, if duly considered, will account for much that is incredible in these narrations. I will here introduce one of the best authenticated ghost stories that ever was told, and which for a long time remained perfectly inexplicable, but which was accidentally explained. This apparition appeared in the town of Plymouth, England. We quote from Sir Walter Scott. 'A club of persons connected with science and literature, was formed at the great sea town we have named. During the summer months the society met in a cave by the sea-shore; during those of the autumn and winter, they convened within the premises of a tavern, but for the sake of privacy, had their meetings in a summer house, situated in the garden, at a distance from the main building. Some of the members to whom the position of their own dwellings rendered this convenient, had a pass key to the garden door, by which they could enter the garden and reach the summer house, without the publicity or trouble of passing through the open tavern. It was the rule of this club, that its members presided alternately. On one occasion in the winter, the president of the evening chanced to be very ill. Indeed, was reported to be on his death bed. The club met as usual, ard from a sen-

timent of respect, left vacant the chair, which ought to have been occupied by him, if in his usual health. For the same reason, the conversation turned upon the absent gentleman's talents, and the loss expected to the society by his death. While they were upon this melancholy theme, the door suddenly opened, and the appearance of the president entered the room. He wore a white wrapper, and a night cap around his brow, which had the appearance of death itself. He stalked into the room with unusual gravity; — took the vacant place of ceremony — lifted the empty glass which stood before him — bowed around — put it to his lips — then replaced it on the table, and stalked out of the room, as silent as he had entered it. The company remained deeply appalled. At length, after many observations upon the strangeness of what they had seen, they resolved to despatch two of their number as ambassadors, to see how it fared with the president, who had thus strangely appeared among them. They went and returned with the frightful intelligence, that the friend, after whom they had inquired was that evening deceased. The astonished party then resolved they would remain absolutely silent, respecting the wonderful sight which they had seen. Their habits were too philosophical, to permit them to believe that they had actually seen the ghost of their departed brother. At the same time, they were too wise men, to wish to confirm the superstition of the vulgar, by what might seem indubitable evidence of a ghost. The affair was, therefore, kept a strict secret, although as usual, some dubious rumors of the tale, found their ways to the public. Several years afterwards, an old woman, who long had filled the place of a sick nurse, was taken very ill, and was attended by a medical member of the club. To him with many expressions of regret, she acknowledged that she had long before attended Mr ——, naming the president, whose appearance had surprised the club so strangely, and that she felt distress of conscience, on account of the manner in which he died. She said, as his malady was attended by a light headedness, she had been directed to keep a close watch upon him during his illness. Unhappily she slept, and during her

sleep, the patient had awaked and left the apartment. When on her own awaking, she found the bed empty, and the patient gone, she forthwith hurried out of the house to seek him, and met him in the act of returning. She got him, she said, replaced in the bed, but it was only to die there. She added, to convince her hearer of the truth of what she said, that immediately after the poor gentleman expired, a deputation of two members from the club came to inquire after their president's health, and received for answer, that he was already dead. This confession explained the whole matter. The delirious patient had very naturally taken the road to the club, from some recollection of his duty of the night. In approaching and returning from the apartment, he had used one of the pass keys already mentioned, which made his way shorter. On the other hand, the gentlemen sent to inquire after his health, had reached his lodging by a more circuitous road, and thus there had been time for him to return, to what proved his death bed, long before they reached his chamber. The philosophical witnesses of this strange scene, were now as anxious to spread this story, as they had formerly been to conceal it — since it showed in what a remarkable manner, men's eyes might turn traitors to them, and impress them with ideas far different from the truth.'

Fortune-tellers often predict some calamity, as sickness or death, which actually comes to pass. Here we see the power of imagination in producing the effect feared. The fear of death has often deprived one of life. An instance of the power of imagination in this respect, is given by Stuart in his journal of a residence at the Sandwich islands, one of the most entertaining and instructive books in our language.

'A thief,' says he, 'was put to flight from our yard one day, while we were at dinner. A lad joined in the chase, and seized the culprit, but lost his hold by the tearing of his outer garment. The thief was greatly exasperated, and immediately engaged a sorcerer to pray the boy to death. Information of this reached the lad in the course of the afternoon; and we soon perceived him to be troubled by the intelligence, though he at-

tempted with us to ridicule the superstition. The next morning, he did not make his appearance with the other boys; and upon inquiry from them, they said he was sick. We asked the nature of his sickness; to which they replied — that he was sick from the prayer of sorcerer perhaps. We found him lying in one corner of his house, pale with fear, and trembling like an aspen leaf, and discovered that he had not slept during the night; we were satisfied that the whole arose from terror; and compelled him, notwithstanding his declaration that he was too sick to come from his retreat — diverted his mind — set him to work, and before noon he was as full of life and spirits as ever — laughed at his fears, and began to defy the power of the sorcerer.'

Here the power of imagination made him sick, and had it not been for friendly interposition, would undoubtedly have deprived him of life. Many persons have from a dream, or from the prediction of a fortune-teller, imbibed the belief that they must die at a certain time. The impression has been so powerful, as to be itself the cause of sickness and death. The experiment tried by three London physicians, has been often mentioned. They agreed to find some rugged and healthy man, and see what effect their reiterated assurance that he was dangerously sick would produce. In the following manner they carried their concerted plan into execution. They went to a road passing over an extensive plain, and a road which was thronged with countrymen crowding into the metropolis. Proceeding along at considerable distances from each other, the first looked earnestly for some suitable subject for their experiment. He had not proceeded far before he met a stout man driving a team, who appeared the very picture of health and strength. 'Good morning, my friend,' said the physician, 'you look too sick to be so hard at work, sir.' 'Sick,' answered the countryman, 'I never had a sick day in my life.' 'Indeed,' said the physician in reply, shaking his head with a look of solicitude, 'that 's bad, such persons seldom survive the first illness. I advise you, my friend, to take care of yourself. I am afraid you are not long for this world.' The physician then rode on. The countryman

began to feel alarmed. He felt of his forehead to ascertain if he were feverish — thought he felt some peculiar sensation of the brain, — and felt a little nausea at the stomach. He had not advanced far on the road, before the second physician met him. 'Friend,' said the gentleman, 'I hope you have not far to travel today; you look as though you ought to be in bed, rather than at work.' 'I do feel rather strangely,' said the man, 'I am afraid I am going to be sick.' 'Going to be sick,' said the gentleman, 'if you were one of my patients, I should fear you were never going to be well. If you value your life at all, I advise you to go home as quick as possible, and send for a physician.' The countryman now began to feel that he was a sick man; faint and trembling he proceeded a little farther, when the third physician met him. He eyed the countryman for a moment with an earnest gaze, and then remarked, 'you must hold your life pretty cheap, my friend, to be out, sick as you are; you look as though you had just escaped from the coffin.' The poor countryman could stand it no longer. His knees trembled, his head grew dizzy, and he was carried into a house, and placed in bed, a *sick man.* And it was the unanimous opinion of the physicians, that if the deception had not been explained, he would have died.

Now is there any difficulty in accounting for the fact, that now and then instances have occurred, in which persons have received an impression, from a dream, or from the prediction of a fortune-teller, that they must die at a particular time, and at that time have died. The firm belief that their destiny was fixed, has produced the sickness and the death. Such is the well known effects of imagination.

It is recorded of a person, who had been sentenced to be bled to death, that, instead of the punishment being actually inflicted, he was made to believe that his veins had been opened, by causing water, when his eyes were blindfolded, to trickle down his arm. The mimicry of an operation, however, stopped as completely the movements of life, as if an entire exhaustion of the vivifying fluid had been effected. The individual lost his life, although not his blood, by this imaginary venesection.

We read of another unfortunate being, who had been condemned to lose his head, that the moment after it had been laid upon the block, a reprieve arrived; but the victim was already sacrificed. His ear was now deaf to the dilatory mercy; the living principle having been as effectually extinguished by the fear of the axe, as it would have been by its fall. Many of the deaths which take place upon a field of battle, without the individuals being wounded in the slightest degree, and which were formerly attributed to the wind of a flying ball, are no doubt to be accounted for from the sedative effects of intense fear. In Lesinky's voyages around the world, there is an account, the truth of which is attested by other navigators, of a religious sect in the Sandwich islands, who arrogate to themselves the power of *praying* people to death. Whoever incurs their displeasure, receives notice that the homicidal litany is about to commence; and such are the effects of imagination, that the very notice is frequently sufficient, with these poor people, to produce the effect. Tell a timorous man, even though he has been brought up amid all the light of civilization, that he will die, and if he has been in the habit of looking up with reverence to your opinion, in all probability he will sink into his grave — though otherwise his life might have been prolonged. Pronounce the sentence with sufficient decision and solemnity, and, under certain circumstances, it will execute itself.

3. The belief in witchcraft was once almost universal. The increasing intelligence of modern times, has nearly swept away this foolish superstition. As in New England the belief in witches is confined to a few of the most ignorant, it will not be necessary to dwell long upon the subject. What is a witch? A very learned writer, has given the following definition. A witch is a person, 'that having the free use of reason, doth knowingly and willingly seek and obtain of the devil, or any other God, besides the true God Jehovah, an ability to do or know strange things, or things which he cannot by his own humane abilities arrive unto. This person is a witch.' A very lucid definition surely. Cotton Ma-

ther has given a very distinct account of the witchcraft, with which this country was agitated in his day. He took a young woman who was bewitched home to his house, that he might, as he expresses it, 'be an eye-witness of things, which would enable me to confute the Sadducism of this debauched age.' It seems that there were persons at that time who, like the Sadducees of old, did not believe in the existence of spirits, either good or bad; who said, 'there is no resurrection, neither angel, nor spirit.' Now it was the avowed object of Mather, in examining the cases of those who were supposed to be bewitched, to obtain arguments to refute this Sadducism. Consequently, he was unqualified for impartial investigation. And the accounts which he gives, bear upon their front the evidences of his being duped by his own feelings. A reward was offered to induce persons to write accounts of remarkable cases, which was a powerful incentive to exaggeration.

Many persons in that period of cruelty and delusion, confessed that they were witches, and that they had bewitched others. But they were compelled to this confession by torture. The usual mode of ascertaining whether persons were witches or not, was to throw them into the water; if they sunk they were innocent; if they floated upon the surface they were witches. Other modes of trial still more cruel were adopted. Probably many persons, during those scenes of nervous excitement, really thought that they were operated upon by demoniacal influence. Witches are in the habit of turning honest men into horses, and riding them over hill and dale, through fen and forest, in the stormy night. I have heard of one poor man who was thus sadly afflicted. Night after night his repose was disturbed by these unwelcome visiters. The witch would come and by her mysterious agency convert him into a horse, place the bridle in his mouth and gallop away to meet her baggard sisters in their midnight revelry. She would tie him to a post, and after dancing for an hour or two with her companions, around the boiling cauldron, return him again to his couch. The poor sufferer would rise in the morning weary with his night's toil, and complain to his friends of the hard

and appalling duty he was compelled to perform. They endeavored to persuade him out of the notion; — told him that it must be the effect of his own imagination. But, no! He knew the place, to which every night, he was compelled to go. He knew the very post to which he was fastened. His companion then told him the next time he went upon one of these nocturnal rambles, to gnaw the post to which he was tied. The man's health was rapidly declining, and to all human appearances, he was hastening to the grave. Another morning he came from his chamber as usual, pale, emaciated and exhausted, with the fear and the toil of the night. 'Again,' said he, 'I have been driven most unmercifully, and if you will go to the post, you will find the evidence of it, for *all* the time I was there, I was gnawing it.' His friend accompanied the enchanted man into the chamber in which he slept, and beheld he had passed a restless night in gnawing his *bed post*. The idea of witchery, had taken so firm a hold of his imagination, and so disordered his nervous system, that he night after night, dreamed, with the vividness of reality, that he was a horse, with a witch upon his back, scouring the hills. Had he in every truth been thus transformed, the effect produced upon him would probably not have been greater. It is hardly necessary to say, that this discovery terminated the power of the supposed witch. There is no difficulty in accounting for their appearance. Human frailty and credulity is so universal — the power of nervous sympathy is so irresistible, that perhaps it is more wonderful, that there is so little of this wildfire of irrational excitement, than that there is so much.

We have, before we close, to state to our readers, that we consider the subject treated in this tract, a very important one, even in this boasted country of light and knowledge. The United States are considered as peculiarly exempt from ignorance and superstition, and though the latter may seldom show itself by any marked and open indications, still occurrences do often take place, which bring to view the latent fears which slumber in the community, and are ordinarily unseen.

We might mention various facts, which show the high-

ly excitable state of the public mind on this subject. We shall, however, speak of but two.

In a town on the banks of the Connecticut river, a man who was employed to dig, we believe for coal, took into his head to obtain assistance in the following singular way. He had heard of the death of a deranged man some years before, and he pretended to have received a visit from his ghost, stating the particulars of his murder, and describing the place where his bones were lying, which the narrator took care should be the place where he had been engaged to dig by the job. His plan was to deceive a few of his companions, and induce them to dig for him, intending after they had helped him a little, to end the joke by a hearty laugh at them for their credulity. The plan took wonderfully. The story spread from house to house, and village to village, and such crowds collected to dig for the imaginary bones, that the contriver of the joke fearing serious consequences, was obliged to seek safety in a sudden departure.

In a village not many miles from Boston, several men were employed in a work shop. One professed to be a firm believer in ghosts, apparitions, &c, affirming that he had frequently seen and held conversations with the ghost of his father, who had been dead many years. One day the ghost believer was told that something very singular had been seen in the meadow, back of the shop where he worked, — that it might possibly make its appearance again that night, and he was requested to go with several others and ascertain what it was. Late in the evening, quite a party collected and went to the place. After waiting some time in suspense, a white figure was seen slowly flitting across the meadow, sometimes distinctly seen and again disappearing. After some consultation, the one who had been so conversant with ghosts, hesitatingly agreed to speak to this unknown being, and taking the Bible in his hand as a defence, advanced. The ghost observing the man approaching, complaisantly remained for a few minutes, stationary. The man tremblingly demanded, why he disturbed the living? A solemn, unearthly voice replied, 'I was murdered, and cannot rest in quiet, until my death is avenged.'

'By whom were you murdered?'

'Mr ———, and my bones were buried in this field. Come tomorrow night at twelve o'clock, and the place where they lie shall be pointed out.'

Here the conversation ended, the man returned to his party, believing that he had seen an inhabitant of the invisible world, and most of those who witnessed the occurrence, were no less credulous. One young man, however, resolved that he would know whether it was really flesh and blood, or not, and fired a gun at it, which he had brought for the purpose, but all believed that it made not the slightest impression.

The next day, the story of the ghost and murder were industriously circulated. Excitement on the subject spread rapidly, not only in that town, but in several adjoining ones, and the next evening, a large concourse of people assembled to hear the disclosures that were to be made. But the wise ghost chose not to make his appearance, when its claims to immateriality would not probably be allowed, without a more thorough investigation, and the disappointed assembly, after waiting several hours, dispersed with their curiosity ungratified, some believing that it was a hoax, others that the ghost was somewhat capricious.

The sequel to this affair was rather a sad one, at least to one of the parties. The young man who had personated the ghost, in order to impose upon his companion, and had while in that character so thoughtlessly accused a gentleman, whose name we have left blank, with murder, was discovered. He was very properly arrested for the defamation, his business was stopped, his property attached, and he narrowly escaped entire ruin.

At last, through the intervention of a third party, the business was settled. He had designed originally only to impose upon the credulity of his fellow workmen, but the feverish excitability of the community in which he lived, produced an extended excitement, and very serious consequences.

In these and in many similar cases the imposture was discovered. In some other cases it may remain for a long time unexplained. Still there is no reason for sup-

posing anything supernatural. There are a great many natural causes, at all times in operation, with which we are but partially acquainted, and others which human science has not yet explored. These are constantly producing effects which may *puzzle*, but ought never to *terrify* us.

Not long since a family in the city of Boston,—and such a case has often occurred,—were troubled for a long time with a mysterious and violent ringing of the bells of the house. A malicious boy will sometimes, when walking the streets, pull the bell of the house door, and then run away, to give some person within the unnecessary trouble of coming to the door. The family we are speaking of, at first supposed this was the cause of their trouble, but the ringing continued, and the mysterious propensity seemed to seize all the bells of the house. The servant would come up from the kitchen. 'Did you ring?' 'No,' was the reply. He would be often summoned to the street door by a violent ringing, and upon opening it, no one was to be seen. There was no chance for any one outside to escape, for the houses extended in a continued block on both sides of the way to a considerable distance. Sometimes the ringing was in the darkness of night,—sometimes at mid-day. A member of the family occasionally watched at the entry, and the instant he heard the bells ring he would open the door suddenly, and grasp at the fancied ringer there; but he always seized—nothing;—except in one instance, when he collared somewhat roughly an intimate friend and neighbor, who happened to come at that instant and to ring honestly. Things continued in this state, until the ringing gradually diminished, and at last ceased altogether. And no light has been thrown upon the cause of the difficulty to the present day.

Here then at last, a superstitious reader will say, you acknowledge something supernatural. Not at all. If we could not imagine any explanation of it, we should not acknowledge it supernatural, when the world is full of natural causes, which we so partially understand. The family in this case, was one of highly cultivated minds, and they saw nothing in these phenomena to excite their fears.

They disliked the trouble and inconvenience occasioned — but they thought of nothing else.

The truth is, we suppose, that all this trouble was occasioned by the irregular contraction of the wires, by which the bell was hung. Were the subject worth a diagram, we could show clearly how this could easily be the case. The scientific reader may perhaps understand a verbal description. Suppose, that near the spring, the wire passed by some point of friction, and then extended to a considerable distance along the wall to the bell pull. Now when this wire contracts by cold, it will acquire a considerable tension, before it overcomes the friction at the point supposed, and then it would move with a jerk, and of course ring the bell. On the other hand, when the wire was expanding by heat, the spring would draw it back by jerks in the same irregular manner. It *ought to* be observed, that it was a new house, where such a friction would be likely to exist, and all the ringing took place in cold weather, when such an alternate heating and cooling was constantly taking place.

We do not say that this is really the explanation; we can only say that this cause is abundantly sufficient to account for the facts, and it shows how natural causes *may* operate to produce effects which may remain for a long time inexplicable.

4. We will make a few remarks in conclusion, upon the efforts which should be used to arrest the progression of these foolish fears. The influence of these feelings is in a greater or less degree, almost universal.

The sailor will climb to the topmast's dizzy height, and there in darkness, when the tempest has broken loose, and wild confusion is warring around him, be fearless and unagitated; and yet will he tremble in his hammock, as he hears the little insect, called the death-watch, ticking in the timber by his side.

The soldier will go undaunted to the bloody conflict and grapple with his foe, and not a nerve will tremble, as the instruments of death are showered around him, and yet will he be afraid to enter the battle field in the night after the conflict, when the ground is strowed with the bodies of the powerless dead.

Said a chief justice of the state of New York, 'I have no faith in signs, and yet I always feel unpleasantly, if I find a pin with the point towards me.' Said another gentleman of cultivated mind, and elevated station, 'belief in these signs is perfectly ridiculous, and yet I cannot for the life of me, see the new moon over my left shoulder, without an uneasy sensation.' The stories of childhood awaken a class of feelings, which it is almost impossible by future efforts to eradicate. Even the most cautious parents, are hardly aware of the greediness, with which children catch these tales. And the parent who appeals to supernatural fears to govern his child, is doing the child an injury which is irreparable. There are many persons who are afraid even to go about their own houses in the dark. How careful then ought they to be who are placing ideas in the infant mind, to exclude these false ideas. If a child be properly taught to trust in God as its father and its friend, it will feel that that protection is as sure in the darkness as in the light. Some children are afraid to go to sleep at night, without a candle burning in the room. What a censure is this upon a mother's instruction. Other children who have been properly taught, are willing to go alone to their chambers, and in the dark find the way to their place of rest. What a testimony does this present, of the faithfulness of parental instruction. This is the advantage which I hope may be derived from the discussion of this subject;—that greater efforts may be made, to keep from the minds of the rising generation, the knowledge of these superstitious notions. We should make the love and the fear of God the basis of education, and upon this, endeavor to rear a superstructure of high, and honorable, and elevated character; lead a man in humility to the footstool of his God, and under the protection of that almighty arm to fear nothing.

SCIENTIFIC TRACTS.

VOL. II......NO. II.

AGRICULTURE ILLUSTRATED BY CHEMISTRY.

Among the numerous and varied occupations of men, if there is any one which may claim a pre-eminence over all the others, it is agriculture; it was the first occupation of man after his leaving paradise; and amidst all the vicissitudes of nations, it has maintained its dignified rank to the present day. Agriculture is not only a most pleasant occupation, but also, absolutely essential to the very existence of the human family.

However a country may advance in riches and luxuries, by means of commerce and manufactures, its existence still depends upon the farmer — the sustenance of man must come from the soil; therefore, every exertion should be made to improve the theory and practice of so important a means of national and individual comfort. The native enterprise and skill of the people of New England, have introduced and carried into successful operation, many improvements in the cultivation of their naturally cold and sterile soil; but without some more efficient means of disseminating the principles of agriculture, as illustrated and improved by science, we fear the time is far distant, when the great mass of our husbandmen shall know and understand by the unerring rules of science, the principles of their occupation.

Many of the arts and trades have had the scientific principles upon which they depend, illustrated, explained, and spread before the great body of citizens, which has added immensely to the mass of individual and national

wealth of our country; and we are clearly of the opinion that when the lights of science shall be carried into the dwelling of every husbandman throughout our land, the day laborer as well as the great proprietor, the same improvement will be seen in agriculture that there is in many of the arts and trades. Such a dissemination of scientific principles as we wish to see, would not only add greatly to the general wealth of our country, but increase greatly the comforts and happiness of its real *bone* and *muscle.* It is with the view to assist a *little* in the spreading of knowledge among the mass of our farmers that the following general principles and illustrations are presented for their consideration.

GENERAL PRINCIPLES.

The changes in the arrangement of matter as they are shown in the growth and nourishment of plants can only be explained by the assistance of chemistry. The nature of soils and the operation of manures depend entirely for explanation upon the same science, and in fact there cannot be an improvement made in agriculture without chemistry.

If a piece of land is unproductive and the farmer wishes to attempt its improvement, the only sure method is to ascertain the composition of the soil and thus ascertain whether it contains any substance injurious to vegetation or whether it needs some peculiar substance added to it.

Some kinds of peat, earth and bog mud constitute a good manure, while other kinds are absolutely poisonous to plants; and the test for ascertaining these facts are obvious applications of chemistry.

Lands that have been injured by excessive cropping cannot be restored to their fertile state without a knowledge of those parts of the soil which have been exhausted by the crops, and chemistry applied in such a case is absolutely necessary.

Every object with which we are surrounded in this world is either organized, having several parts, which united form a whole, which is capable of increase by receiving nourishment; or they are inorganized and capable of increase only by additions to their exterior parts.

To the first class belong animals and plants, to the second belongs the mineral kingdom. The vegetable kingdom is the middle link in the chain of creation, between the animal and vegetable kingdoms. Vegetables like animals have a certain set of organs by which they receive their food, digest it, and convert it into their own substance, reproduce their species and live a longer or shorter time; but they differ from animals in not being endowed with a consciousness or feeling.

Plants absorb their nourishment from the soil in which they grow and from the atmosphere; and by means of their organs convert it into their own substance, and as we find each individual plant to possess some distinct and peculiar substance, we cannot form a distinct conception of the *reasons* of vegetation, without some general knowledge of the substances which when united make the whole plant, as well as some of the changes which these substances undergo when placed in certain circumstances. All the different parts of plants may be resolved by decomposition, into a few substances; the uses of the plants in the arts, and as articles of food depend upon the arrangement and combination of these simple substances.

The examination and analysis of these into their *ultimate* parts belongs to the professed chemist.

The examination of vegetables with a view to discover their different principles is performed either by mechanical or chemical processes.

The mechanical processes are cutting, rasping, pressing, &c, sometimes natural causes operate to produce the same effect; hence the origin of gums and other spontaneous exudations; at other times artificial processes are necessary, as in the extraction of oils from seeds, &c.

The chemical means are distillation, burning, the action of water, acids, oils and alcohol, and fermentation; pitch and tar are obtained by the distillation of resinous wood; charcoal by burning; tan or tannin, starch, &c, by the action of water.

By these processes we obtain vegetable substances, and these again may be divided into their ultimate elements.

Plants are therefore composed of various vegetable

substances which are themselves compound. It is only of these compound ingredients of vegetables that we shall treat in our inquiries.

OF THE COMPOUND INGREDIENTS OF VEGETABLES.

Acids. Numerous acids are found in plants, all of which will dissolve in water, and all sour to the taste; they are found in the juices or organs of plants; these are oxalic, citric, acetic, malic, gallic, tartaric, benzoic, and prussic.

Oxalic acid is found united with potash (pure) in the leaves of wood sorrel, (*oxalis accetosella*) garden sorrel, &c; it is found in the root of parsley, and in the bark of ash, oak, elm, in all of which cases it is found as a salt (*oxalate of potash*) which is used in medicine and the arts.

Citric acid, is found unmixed in the juice of limes, lemons, oranges, cranberry (*Oxycoccus*) and some other plants.

Acetic acid or vinegar, is found in the sap of several trees, and in the juice of the *chick pea*, (*cicer*). The wood of *red oak* is distilled, to procure vinegar.

Malic acid. The following fruits owe their acid flavor to this acid; apples, barberry, plum, &c, and united with citric acid it is found in gooseberries, cherries, &c.

Gallic acid is found in the gall nut and in the bark of many trees. It is extensively used in dying black colors, and is the basis of writing ink. Sumach contains a very large proportion of this acid, hence its use in the arts.

Tartaric acid is found in the juice of grapes and in the mulberry and some others.

Benzoic acid is a peculiar acid obtained from gum benzoin and from balsam of Tolu; it is used in medicine.

Prussic acid is found in all the better tasted kernels of fruit, as the almond, peach, cherry, &c, likewise in the leaves of laurel; this acid is used in medicine.

All of these acids when decomposed are found to be formed of different proportions of carbon (pure charcoal) oxygen, and hydrogen, except the prussic, which contains also a portion of nitrogen.

Gums issue from certain kinds of trees, particularly

from stone fruit trees, and are always soluble in water. Gum is extensively used in the arts, particularly by calico printers to give a body to their colors. Gum is one of the most nutritious substances as an article of food.

Sugar is obtained from a great number of plants. That of the purest kind is obtained from the sugar cane, and is very similar in its ultimate composition to starch, which may be made into sugar, as is exemplified in making malt. Barley contains a large proportion of starch, which by the process of malting is made to absorb oxygen (*vital air*) and this combines with a part of the carbon of the starch, and thereby converts it into sugar, and this by fermentation is converted into the spirit of the beer. The same principle is illustrated in the freezing and thawing of potatoes. Potatoes contain a large quantity of starch, which the frost and after heat, converts into sugar by the same means as in the case of malting; hence the sweet taste of potatoes and similar vegetables after being frozen and thawed. All vegetables which contain a considerable portion of starch, are operated upon in the same way by being frozen and thawed. If any such vegetables are thawed after being frozen when excluded from the air, as being covered with water, there will be but little sugar formed, and therefore the vegetable will be but little injured by being frozen.

Sugar is found ready formed in many plants, as in the sap of the sugar maple, in the juice of ripe grapes, in the root of the beet, &c, &c.

The utility of sugar is too well known to require any detail from us.

Starch is a well known vegetable substance and is procured in abundance from wheat flour and potatoes.

Starch forms the principal part of all esculent plants, commonly in the seeds or roots, as oats, rice, indian corn, peas, beans, acorns, &c, all owe their utility as articles of food to the starch which they contain.

Starch is obtained from seeds by soaking them in water, and then pressing out the milky juice, which on settling, deposits starch; and from roots by reducing them to pulp and then pressing out the milky juice.

The starch which these vegetables contain is soluble

in water, while the other parts of the vegetable are insoluble, hence the reason of the process.

Sago is starch extracted from certain species of palms growing in the East India islands. Salop is starch extracted from the root of the *Orchis* growing in the East.

Gluten is obtained by cautiously washing and kneading a piece of dough made of wheat flour under a small stream of water, by which means the starch and other soluble parts are washed out and the gluten being insoluble, remains in the hand. Gluten is the most nutritive vegetable substance known, and it is this substance which causes the panery fermentation in all meal, none is capable of being made into light bread without it. Wheat contains a large portion of this substance, hence its superiority as a bread grain. Paste for book binders, paper hangers, and others, is made of wheat flour, and to be good should have all the starch washed out, which may be done best by raising the paste with yeast first, and then washing it in water.

Extracts. When plants or parts of them are bruised in water, a part of the vegetable will be dissolved, and by evaporating this solution, the vegetable substances contained in the water, will be obtained in a separate state; this is called *extract*. It is evident that this principle has not one distinctive character, but varies according to the plant from which it is obtained, and even the same kind of extract will not always possess the same character, as it depends upon the soil in which the plant grew and other accidental causes.

Almost all of the vegetable substances used in dying are used as extracts, which having a strong attraction for the fibres of cotton, linen, &c, readily combines with them, when boiled is a solution of them; but in some cases the extract does not adhere strongly enough without the assistance of some other substance, called a *mordant*, which is some earthy or metalic substance, as alum (*sulphate of alumine*) or copperas, (*sulphate of iron*) these fix the colors and render them permanent.

Extract is found in the sap, bark, leaves, wood, and flowers.

Tannin, or the tanning principle is that vegetable sub-

stance which is obtained from different kinds of bark and is used for tanning leather. The distinctive character of tannin is its action on a solution of isinglass, glue or jelly, with which it forms an insoluble compound.

Tannin is not a nutritive substance, but it is of very great importance in the manufacture of leather. The skins of animals consist almost entirely of jelly or *gelatine* in an organized state, and is slightly soluble in boiling water. When a skin is placed in a solution of tannin, its jelly slowly combines with it and the skin becomes insoluble and is no longer liable to putrefaction, but is leather.

The bark of the oak, hemlock, (*Pinus canadensis*) and lately the Spanish chestnut, are the most used in this country by the tanner. The bark of many other trees contains this principle, but the yellow oak (*Quercus castanea*) is prefered in New England for tanning leather.

The quantity of tannin found in barks differs according to the season of the year; when the spring has been cold the quantity is the least. On an average 4 or 5 pounds of good oak bark will make one pound of leather, and about three times as much hemlock bark is required for the same process.

Barks contain the greatest quantity of tannin at the time the buds begin to open; but, in this country the bark is obtained at the time it will peal, that is, about the time the leaves have attained their full size, when the sap begins to descend, which it does between the bark and wood.

The common belief among farmers that bark will not peal except at a particular age of the moon, is not founded on reason or fact.

Acids combine with tannin and produce soluble compounds, and acid (*Sulphuric acid, or oil of vitriol*) is used in tanning some kinds of leather to render it more solid; and when the bark contains potash or soda (as it does sometimes) the tannin is not very soluble; in such a case an acid will take up the potash and render the tannin soluble.

Indigo is another peculiar vegetable substance found in a small number of plants, as the indigo plant, woad (*Isatis tinctoria*) and a few others.

The Narcotic principle, is a certain vegetable principle found in plants, which has the property of inducing sleep, and in large doses of producing death. It is found in the juices of some plants as the poppy (opium) and in the leaves of others, as lettuce and many others.

The Bitter principle is a peculiar bitter substance found in a great number of plants, and is of great importance in the art of brewing, as it checks fermentation, and therefore, preserves fermented liquors. This principle is found abundantly in the flowers of the hop, for which it is extensively cultivated ; it is also found in many other plants.

Resins are found in most kinds of pine, and are supposed by chemists to be a volatile oil rendered hard by oxygen ; in its pure state it becomes a true balsam. There are many kinds of resin, the scrub pine (*Pinus sylvestris*) of Maine, yields common turpentine ; common larch, venice turpentine ; the different species of pitch pine (*Pinus rigida, &c,*) yield pitch and tar. Turpentine is spirits of turpentine and *rosin* which are seperated by distillation.

Fixed Oils. There are two kinds of oil found in vegetables, fixed and volatile ; fixed oils, are such as cannot without great difficulty be dissipated by heat, while volatile oils are easily evaporated.

Fixed oil is generally found in the seeds of plants, sometimes in the pulp of the fruit, as in the olive ; some seeds yield their oil by simple pressure, while others require heat also. There are two kinds of fixed oils, fat oils, and drying oils ; by contact with the atmosphere the former are converted into a buttery substance, while the latter are made solid, in consequence of the absorbtion of oxygen which converts them into another and different substance.

Olive oil, which is expressed from the pulpy part of the fruit of the olive (*olea europea*) is the principal fat oil, and is manufactured in France, Spain, and Italy, where it is extensively used instead of butter. Rape-seed oil is another, and obtained from rape seed.

The principal drying oil is that obtained from flax seed, called linseed oil ; it is obtained by roasting the seed and

then pressing it; the roasting dries up the mucilage of the seed and prevents its coming out with the oil. Nut oil is obtained from the kernels of various kinds of nuts, as filbert, black walnut, &c, by roasting and pressing. Poppy oil is obtained from the seed of the poppy, which is cultivated in France and Belgium for this purpose; this oil is frequently sold and used instead of olive oil. Hempseed oil is another drying oil, which is extracted from hemp seed, and is used by painters in this country, and as an article of food in Russia.

The fixed oils are very nutritive substances and of great use in the arts. Oils are apt to become rancid in consequence of the fermentation of the small quantity of mucilage which they contain; they may be preserved from this, by agitation in water, which will dissolve the mucilage and leave the oil pure.

Volatile Oils. The peculiar odor of plants is supposed to be owing to a peculiar oil which is easily evaporated by heat, which distinguishes these oils from the fixed oils. Volatile or essential oil, is found in every part of plants, in the roots of some, in the bark, wood, leaves, flowers, &c; these oils are obtained principally by distilling the plant. Volatile oils are soluble in alcohol, (*spirits of wine*) and in strong rum and whiskey; hence the mode of manufacturing the essences which are hawked about the country in large quantities.

Woody fibre. If a piece of wood be well dried and then soaked first in water, and then in alcohol and other solvents, until the liquor comes away colorless, there will remain behind a kind of skeleton of the wood first used; this is called woody fibre. Every plant has a kind peculiar to itself, which by distillation yields charcoal; in fact charcoal is made by exposing wood to heat, which drives off the volatile parts and leaves woody fibre, which by further exposure to heat is converted into coal (*carbon*).

The following experiments have been made to ascertain the quantity of charcoal which may be obtained from 100 parts (by measure) of the different kinds of wood used for making charcoal in New England.

100 parts of White oak will yield	21,4	parts of coal.
Beech	17,	"

100 parts of	Yellow birch will yield	19,2	parts of coal.
	White and Rock maple	18,9	"
	Hickory	20,1	"
	White pine (young)	16,	"
	Pitch pine (young)	16,4	"
	Chestnut	19,	"

It requires from 3 to 5 cords of wood to make 100 bushels of charcoal in the manner it is made in New England. Charcoal is one of the most indestructible substances known; it is not materially affected either by water, air, or insects, hence the utility of charring posts and other timber which is to be placed in water or in the ground. Pounded charcoal is an excellent preserver of animal and vegetable substances from putrefaction; it will purify water and other liquids and destroy their bad taste and smell.

Wax. The upper surface of the leaves of many trees is covered with a kind of varnish, which has been found to possess all the properties of *bees-wax.* Wax is found in a great number of plants; it is obtained in abundance from bayberry (*Myrica ceriferra*) by placing the berries in hot water. Bees obtain wax from the sugar in plants and its color is owing to pollen. Wax is of extensive use in the arts and in domestic economy. Wax is found to be a fixed oil combined with oxygen; and fixed oils may be converted into wax by exposure to the atmosphere. Upon this property is founded the use of fixed oils in painting. Hence the use of boiling oils and red lead together as practised by painters; the red lead is oxygen and lead combined, or a rust of lead, (*oxide of lead*) and the oil takes away a part of the oxygen from the red lead and combines with it, which makes it dry quicker than it would in its raw state.

There is a large number of other peculiar substances found in vegetables, which are useful to man as a social and civilized being, evincing the most unlimited benevolence in the Divine Being who has so plentifully provided for the wants of every living being of his creation; but time and space would fail us to describe the whole and we have therefore mentioned only the most important of them.

OF THE FIXED ALKALIES.

It is well known that the ashes of vegetables yield a peculiar substance which is capable of forming soap when combined with oil or fat; this substance is an *alkali.*

If the ashes of *land* plants be washed repeatedly in water and the washings evaporated to dryness, the substance called potash is obtained; the potash of commerce is manufactured in this way, and is an impure carbonate of potash, (*dead or fixed air combined with pure potash.*) When potash is pure it is extremely caustic and changes vegetable blue colors to green; and with silex (*pure flint or sand*) it melts and forms glass.

Pure potash Sir Humphry Davy discovered to be a peculiar, and singular metal combined with oxygen.

If the ashes of *marine* or *sea* vegetables, be washed and treated as above, a substance similar to potash will be obtained, which will form a *hard soap* with oil, while potash forms a soft soap, this is called soda or mineral alkali; the barilla of commerce is an impure carbonate of soda (*fixed air combined with pure soda.*) Sir H. Davy also disovered this to be a peculiar metal combined with oxygen.

These are called *fixed alkalies*, because heat will not evaporate them; and they are found in vegetables in the state of salts, such as carbonates, (*carbonic acid or fixed air, and alkali*) sulphates, (*sulphuric acid or oil of vitriol, and alkali*) or muriates, (*muriatic or marine acid, and alkali;*) these salts form the principal part of the ashes of all green herbaceous plants: the ashes of the bean, turnsol, wheat, &c, contain three fourths of their weight of alkaline salts.

Herbaceous plants furnish four or five times, and shrubs two or three times as much potash as trees; leaves produce more than the branches, and the branches more than the trunk, and green plants produce more than dry.

Here then, we have an explanation why new cleared lands, on which a large quantity of leaves and wood have been burned, produce larger crops of grain (wheat, rye, indian corn, &c,) than old lands; these grains require a

large quantity of alkali in their formation, and the leaves and wood furnish this alkali. Hence also the utility of ashes as manure, and it is highly probable that common (*marine acid and soda*) salt is an excellent manure when used in proper quantities for certain kinds of plants.

EARTHS.

Lime, silica (*silex*, *pure flint*) magnesia, &c, are called earths, and are all found in plants in a greater or less degree.

Lime is the most abundant earth found in vegetables; it is found combined with acids forming salts, such as carbonate of lime, (*limestone*, *chalk*, *&c*,) phosphate of lime, and sulphate of lime, (gypsum.) The phosphate of lime is an abundant ingredient in the ashes of plants, particularly in green herbaceous plants whose parts are in an active state of vegetation.

Silex or silica is not very abundant in vegetables; most grasses contain it, and also plants of the equisetum genus (*rush*, *cane*, *&c.)* It is owing to the silex which these plants contain that their surface is so hard.

Magnesia and alumine (*pure clay or argile*) are only found in minute quantities in vegetables, except in some few marine plants, hence the reason of the well known fact, that gypsum (*plaster of Paris*,) which contains these earths is injurious to vegetation.

The ashes of some plants contain small portions of certain metals, such as iron, copper, &c, but in such small quantities as renders it doubtful, whether they are a product of vegetation or not; yet there are certain plants which will not thrive well without a small quantity of iron in the soil in which they grow, as the vine from Europe, the fig tree, and a few others, because these plants are natives of a volcanic country; hence the utility of smith's cinders in such cases as a manure.

Such are the principal compound ingredients of plants and all of these are composed of three or four simple or uncompounded substances, carbon, oxygen, hydrogen, and in some cases, azote; these form the very essence of vegetable substances.

How wonderful are the operations of nature, that all

of the vast variety of vegetables, some so different from others, should all be found of the same ultimate principles, the difference being produced only by the difference in the proportions and arrangements of these elements.

SUBSTANCES OF THE SAME COMPOSITION.

Chemists have found that *gum* and *sugar* are composed of the same elements ; and starch differs from these only in containing a little more carbon. The dissimilar properties of these substances is owing to the difference in the arrangement of the elements. It will be reasonable then, to suppose, that gum, starch, and sugar, are convertible into each other, which is the fact ; the sweet taste of corn and other grains at the time of ripening is owing to sugar in the plant at that time, which is gradually converted into starch ; while in the process of *malting* the starch of the grain is converted into sugar. In the former case carbon is absorbed and assimilated by vegetation, while in the latter, oxygen is absorbed, which unites with a portion of the carbon of the starch and forms carbonic acid, (*fixed, or dead air*) which is given out.

The vegetable acids for the most part, are convertible into each other ; these differ from other vegetable principles by containing less hydrogen and carbon, consequently, many of the vegetable principles are convertible into acids by exposure to the atmosphere, merely by increasing these two elements. Acetic acid (*vinegar*) contains less oxygen than any other ; hence the readiness with which this acid is formed from other soluble vegetable substances, for almost any vegetable substance dissolved in water will become sour, like vinegar, by exposure to the air.

ARRANGEMENT OF THE VEGETABLE PRINCIPLES IN PLANTS.

The basis of all the solid parts of plants, is *woody fibre ;* it constitutes the greatest part of the heart, wood, and bark of woody plants, but there is not much of this principle in the sap-wood, leaves or flowers.

Sugar is abundant in plants ; it is found in every part of the plant ; the sap-wood of some trees contains it in

large quantities, as maple, birch, &c. The leaves of some plants contain sugar in abundance, such as cabbage; while the roots of others contain it, as the beet, parsnip, turnip and carrot; it is the saccharine matter contained in these which gives them their value as articles of food.

3840	grains of	cabbage leaves	contain	92	grs. of sugar.
3840	"	English turnips	"	130	"
3840	"	Carrots	"	364	"
3840	"	Parsnips	"	345	"

It is by such an examination of vegetable substances, that we are enabled to ascertain the comparative utility of each as articles of food for man, or beast, because sugar is very nutritive, and its quantity in most cases may be taken as a fair criterion of the value of vegetables.

Fruits contain a large quantity of nourishment laid up in their cells for the use of the embryo plant: mucilage, starch, and sugar, are found in many cases combined with vegetable acids. Most of the fruits in common use have been naturalized on account of the sugar combined with acids and mucilage which they contain, because they are pleasant to the taste and nutritious.

Bulbous and some other roots, contain, deposited in their cells, a large quantity of starch, albumen, and mucilage, which is intended for the nourishment of the shoots made in the spring. The potato contains a very large quantity of soluble matter, which constitutes its value as an article of food.

Starch forms the principal part of the seeds and grains used for food; in bread grains it is combined with gluten, in peas and beans with albumen, in flax and rape seeds with oils. In general, the grains of warmer climates contain more gluten and other insoluble matters, than those of cold climates; hence farmers in procuring new seed should prefer that from cold climates.

Mucilage is found in nearly all fruits, bulbs, and grains, and constitutes a valuable part of their nutritious qualities.

The fragrance of flowers is owing to volatile oils, which by constant evaporation surrounds them. The peculiar smell of many kinds of wood is owing to the same cause.

Aromatic woods are peculiarly obnoxious to insects, and

remarkable for their indestructibility, as camphor-wood, cedar, cypress, rose-wood, &c. The gates of Constantinople, which were made of cypress, stood entire for more than 1100 years.

Having gone through with an examination, in a brief manner, of the most important vegetable substances, together with their arrangement in the plant, we shall next proceed to examine the manner in which these are produced, together with the chemical principles involved in the growth and nourishment of plants, and endeavor to trace some of the processes. The wonders of the vegetable kingdom are but imperfectly known even at the present enlightened day, and there is scarcely a process as performed in the great laboratory of nature, which can be accurately followed. The multiplicity of operations going on at the same time and in the same place, astonish and confound. The harmony and skill, too, are vivid manifestations of that Divine power that painted the tulip and balanced the universe.

OF GERMINATION.

Germination is that operation of the vegetable principle by which the seed is converted into a plant; for it has been completely proved that all vegetables arise from the seed.

Every seed (except ferns, lichens, &c) consists of three parts, the *cotyledon*, the *radicle* and the *plumula*. Some seeds have only one cotyledon, as wheat, oats, and all the grasses; some have two, as the bean, &c; while some have more; garden cress has six.

If a common bean be soaked a short time in water, the two skins which are outside may be easily pealed off, when the bean may be divided into two parts or lobes, these are the cotyledons; near the eye of the bean, between the two lobes, may be seen a small oblong roundish body, which is the radicle or future root, on one end of which will be seen a small body resembling a leaf in shape; this is the plumula or future stem.

If the seeds of any plant are placed in situations and under certain conditions, they will germinate and begin to grow, and in time will produce a mature and perfect plant; the conditions are these;

1st. The seed must have reached maturity, or the nourishment laid up in the seed will not be in a fit state to support the embryo plant, nor will the organs perform their functions. Some seeds begin to germinate in the seed vessels, as the common radish; others require to be planted very soon after they have reached maturity, as the coffee-bean, while the most of seeds if gathered without any external injury and preserved in a dry situation will keep good for many years. If the seeds are not *perfectly* ripe, but enough so, to sprout and grow, the plants produced will be unhealthy. Hence the utility of having seed corn, seed grains, &c, perfectly ripe, and it is said that wheat produced from perfectly ripe seed is not so liable to smut and blight.

2d. The seed must be preserved or covered from the action of light; hence the practice of farmers and gardeners in covering their seeds with earth; hence also the error of those who sow grass seed without harrowing it; sometimes the seed sprouts and grows, but in most cases it fails, or produces unhealthy plants.

3d. A certain degree of *heat* is necessary; seeds will not germinate at or below the freezing point, yet cold does not destroy the vital powers of many seeds. Every seed has a peculiar temperature at which it begins to sprout; hence each kind of seed has its peculiar season at which it will germinate best, and this season varies with the degree of heat; this is the reason seeds from a warm climate when planted or sowed in a colder one will sprout sooner than those grown in the cold climate.

4th. It is well known that seeds will not germinate unless moisture have access to them. Seeds kept perfectly dry never sprout; *water* therefore, is necessary to germination. Hence the acceptableness of rain to the farmer immediately after his seed is sown. Too much water is injurious (except for aquatic plants) to seeds, as it will cause them to rot.

5th. Atmospheric air must have access to seeds or they will not germinate, and as this is composed of a mixture of three airs or gases, oxygen, azote and carbonic acid gas, it is necessary to know whether all of these, or only a part is necessary; by numerous experi-

ments, it has been found that oxygen or a mixture of which it is a part, is the only one in which seeds will sprout, in pure nitrogen (azote) or pure carbonic acid gas, seeds will not germinate, yet these both seem necessary, either of themselves, or to modify the action of the oxygen.

The time necessary to complete the process of germination is different for different plants; the grasses are among those of the most rapid germination, then come those whose flowers have four petals placed in the form of a cross (*cruciform*), then umbelliferous plants (flowers on stems like an umbrella, as the carrot) and lastly roseaceous plants (*flowers like roses.*) The following table exhibits the times of germination of a number of seeds in New England.

	Days.		*Days.*
Wheat, Rye, &c, -	4	Barley, - - -	7
Beans, Mustard, - -	5	Cabbage, - - -	9
Lettuce, - - -	5	S. Marjorum, Parsley,	30 to 40
Melon, Cucumber, -	6	Chestnut, Peach, Oak,	1 year.
Radish, Beet, - -	7	Rose, Hawthorn,	2 years.

It is to be perceived then, that seeds will not germinate unless heat, moisture, and oxygen gas are present; but why are these necessary? what changes do they produce in the seed?

We have already stated that most seeds have one or more cotyledons; these cotyledons contain a large quantity of farinaceous substance (*starch, gluten, mucilage*) which is there deposited for the nourishment of the infant plant, before it is capable of drawing it from the soil and air. But, this food is not yet fitted for this purpose, and some change must be wrought upon its properties. The moisture of the ground is imbibed by the seed and mixes with the starch, &c, and forms a kind of paste, while the oxygen of the air is at the same time taken up, which combines with a portion of the carbon (charcoal) of the starch and forms carbonic acid, which is given out, thus changing the starch into sugar or an acid; while the heat is necessary to set the dormant life of the plant in motion; so that a part of the operation is precisely similar to the malting of grain for making beer. The visible effect first produced is the swelling of the seed; the radi-

cle expands, bursting the cotyledons and finally fixes itself in the soil; the stem and leaf expand and with the cotyledons make their appearance above the ground, and as soon as the root is sufficiently prepared, the seed leaves or cotyledons fall off and the plant extracts its nourishment from the ground and atmosphere, and a plant is produced capable of producing seed in its turn. If the cotyledons or seed leaves are broken off before the plant has reached a certain stage of its growth the plant dies, because it is deprived of its nourishment.

Thus far the facts are obvious, but the *manner* in which the effects are produced is hidden from our knowledge; we neither know how the food is conveyed, nor how it increases the size of the old parts and forms new ones; this is one of the mysteries of nature which the mind of man is not yet able to comprehend.

OF THE FOOD OF PLANTS.

Plants after they have germinated continue to increase in size, until a certain age, when they die and decay; a tree for instance, increases in every part, and a new layer of wood is produced every year; besides which, the branches increase in length, as well as the roots, and a new coat of leaves has been formed.

From this, it is evident that a great quantity of new matter is continually making its appearance in plants, and as they cannot *create* this new matter, it follows, that they receive it from the soil, or from the atmosphere through some channel—plants then like animals require food for their growth.

The soil in which plants grow is composed of earth, water, vegetable mould, decayed animal substances, salts, ores, alkalies, and gases; in the atmosphere is found oxygen gas, nitrogen (azote gas,) carbonic acid gas, and vapor, together with innumerable particles of all the solid, liquid, and gaseous bodies, found upon the earth, which are wafted upon every breeze. All of the ingredients of the soil and air are not taken up by plants indiscriminately and converted into food, because it is well known that all kinds of plants will not thrive in every soil; each plant selects those substances which are adapted to its nature. But, in what state is the food taken up by the plant and what are the proportions of the ingredients?

Let us then consider each kind of food separately.

Water, it is well known, is essential to vegetation; it is taken up by the plant in a pure state and converted in part into food, and a part of it is given off again through the leaves; water also, is necessary to dissolve the other parts of the food, in order that the minute pores of the roots may receive it. Most plants require a certain degree of moisture in order to vegetate well; rice would not grow in a soil that is adapted to produce wheat on account of too much water.

Air. It has been long known that plants will not grow without air; a large portion of the carbon *(pure charcoal)* which plants contain is absorbed from the air in the form of carbonic acid gas *(fixed air,)* but plants will not grow in pure carbonic acid gas, and mixed with other gases in any greater proportions than it is found in the atmosphere is injurious to vegetation, and when we remember that this gas is produced in great abundance by combustion, by animals, and by plants, we cannot fail to be astonished at the manifestation of Divine Goodness in mixing these gases of the atmosphere in so exact a manner as produce such wonderful effects. Plants also derive a portion of the oxygen they contain from the air.

Vegetable extract, or mould. When plants have reached their maturity they gradually begin to decay, and finally are converted into dust or vegetable mould and then become a part of the soil; but this mould is again converted into food for other plants after being dissolved in water; this is *extract.*

The proportion of extract found in soils is much less than is generally supposed; the writer of this tract repeated some experiments which were made in France, to ascertain the quantity furnished by some New England soils.

From 10 pounds of mould, from a garden cleared from the wilderness 50 years since, and well manured every year he obtained only 3¼ ounces of dried extract; and 10 pounds of mould taken from a well cultivated field, cleared 40 years since, yielded only ¾ of an ounce of dried extract; and it is probable that even this small quantity, is more than sufficient for the bare purposes of vegetation.

Besides this fertile vegetable mould or extract, there is another called *sour vegetable mould.* It is found in low grounds, as swamps, marshes &c. This mould differs from the above, by containing a portion of phosphoric and acetic *(vinegar)* acids. The extract contained in such mould is chiefly insoluble, hence the barrenness of such soils until altered by manures.

Most kinds of manures owe their efficacy to the quantity of extract which they contain. *See our other tract on this subject, article 'Manures.'*

Salts. We have already said that certain kinds of salts are found in plants; clover and lucerne always contain plaster *(gypsum or sulphate of lime)* and therefore, these plants receive this salt as a part of their food. Wheat, indian corn, &c, contain phosphate of lime, therefore this salt constitutes a part of their food, and the same can be said of many other plants, where they contain any peculiar salt, the same is found beneficial to their growth. *See 'Manures.'*

Earths, such as lime, silex, and some others, are found in some plants, which they obtain from the soil principally, and the quantity found in plants varies according to the nature of the soil in which they grow.

These are the principal ingredients of the food of plants; the supply from the atmosphere is tolerably regular, except moisture, and even this for a whole year is pretty regular; but the supply from soils is not so regular, and as these are more within the reach of man, the supply may be regulated by human agency.

Plants receive their food from the soil only by the extremities of their roots; hence the reason the roots increase in length so rapidly, in order as it were, to go in search of food; hence also, ploughing deep between the rows or drills of plants (indian corn, &c,) is injurious, because it destroys some of the roots. If the extremities of the roots be cut or broken off they never increase in length, but send out branches.

The extremities of roots contain no visible opening, hence we may conclude that their food must be in a minute state of division, perhaps dissolved in water, and it is found that every substance which is found in plants, is soluble in some particular state of combination.

VEGETABLE NUTRITION.

All plants contain some peculiar juice or juices, and as soon as the food enters the plant it mixes with these juices and constitutes the sap of the plant. The sap is most abundant in the spring of the year, when vegetation awakes as it were with renewed vigor.

As soon as the food has entered the plant and mixed with the matter deposited in the sap vessels the fall before, it ascends to nourish the buds and leaves, during which time it is continually mixing with new matter — hence the sap at different heights has different properties; sap near the ground is almost tasteless, while at four feet from the ground it has all the properties of sap.

The matter laid up by the plant for mixing with the food of spring, is found entirely in the sap-wood, *alburnum* therefore, the sap-wood is heavier in winter than in summer, hence timber or wood felled in winter is heavier and more durable than that cut in summer.

From experiment it has been found that the sap ascends with great force; the sap of a grape vine ascends with a force capable of supporting a column of murcury (quick silver) 332 inches high. The sap ascends through the sapwood to the leaves, where it is operated upon by the air and converted into the *true sap*, and these changes are partly produced during the day and partly during the night. As soon as the sap reaches the leaves a part of it is thrown off by evaporation, and this transpiration is much promoted by sunshine and moisture; hence the good effects of alternate sunshine and showers on vegetation.

The upper side of the leaf gives out moisture and the under side absorbs it.

From numerous and ingenious experiments it has been found that plants during the night absorb oxygen gas, which combines with the carbon of the plant and forms carbonic acid gas, (*fixed air*) which during the day is decomposed and its oxygen is given out. Thus it appears that plants like animals *breathe*, but differently during the day and night; during the night they inhale oxygen and exhale carbonic acid, during the day they inhale carbonic acid (*fixed air*) and exhale oxygen gas. Plants during the night absorb moisture and during the day they give it out.

It is by these processes and perhaps others which have not yet been discovered, that the sap is changed and brought to a state fit for the nourishment of the plant; but the *manner* in which these changes take place is yet unknown; but it is probable however, that carbon is formed or increased during the day, and oxygen and hydrogen during the night.

The leaves of plants may be considered the stomach or digestive organs, and are not merely ornaments, but a most important part of the plant. Hence a plant stripped of its leaves does not grow until new leaves are formed, hence the reason that fruit and other trees, whose leaves have been destroyed by insects do not ripen their fruits; and if the leaves be stripped or injured by insects for several years in succession, the plant languishes and dies.

The *true sap* is conveyed to every part of the plant, and all the substances found in plants, even the organs themselves, are formed from it, and the whole of the operations are purely chemical.

How wonderful is the goodness and wisdom of that Being who created and nourishes all of the works of the Universe! These works are surely worthy of man's attention and study.

In another number we shall treat of soils, manures, and some other parts of agriculture capable of illustration by chemistry.

In conclusion, however, we wish to offer a few remarks in regard to the use which a practical farmer is to make of his scientific knowledge. It certainly appears most reasonable that he should seek and obtain a knowledge of the substances with which he works, their various properties, and the laws of their operation.

One would suppose that the farmer who possessed this knowledge would discover many modes of facilitating his processes. His scientific principles, we should expect, would come in to help him out of many of his difficulties, and to guide him to more perfect results than he could secure without them. But this is not always the case in fact. It is not unfrequently true that a man will obtain a slight and superficial knowledge of science, and then, in his endeavors to apply that knowledge prac-

tically, he will, through his partial ignorance, make so many mistakes, and neglect the consideration of so many apparently slight but really important particulars, that his plans fail, or secure only such partial success that his expected improvement is far inferior to the old established method, which he is endeavoring, by his science, to amend.

It is so in other sciences than those connected with agriculture. Perhaps these remarks apply more fully to the mechanic arts. A man obtains some little knowledge of the principles of the pressure of water and of the operations of water wheels. Though his knowledge is in a high degree superficial, he thinks he understands the subject thoroughly, and fancies that he can improve the construction of the wheel, so as to avoid the difficulties by which the motion of the common undershot wheel is impeded. He draws a plan, and his theory in regard to the motion of his new invention is probably correct so far as it goes. But the fatal difficulty in regard to it is, that he has not taken into consideration a multitude of causes which operate most powerfully on the result. He has diminished the retarding influence of one which he could see, but he has increased that of several others, which were out of his view, so that when his new invention is completed, at a considerable expense to him, he finds that it succeeds only almost as well as the old established wheel, which he is trying to improve. Still his failure is not a very striking one, if it was, it would discourage him at once and the mischief would end here; but no, he attributes his disappointment to some trifling accidental cause, which would not operate in any other case, or he sees some little difficulty which he can easily remove, and he is thus allured on, from one expensive experiment to another, until his resources both of enterprise and capital are exhausted. During all the while his neighbor who has been grinding steadily on, with the old well tried wheel, has, notwithstanding all its imperfections, been steadily doing useful work for others, and acquiring property for himself.

This is substantially the history of a thousand abortive plans of improvement, both in agriculture and mechanics.

And what are the inferences from these facts. We can sum them up in the following precepts.

Seek a most thorough and extensive knowledge of your business.

Never attempt expensive experiments unless you have the most decisive and unequivocal proofs of their success upon a small scale.

Remember that the true object of the diffusion of scientific knowledge among the mass of the community is, not to enable every man to make some splendid improvement, but to facilitate minor operations, to guide in unforseen emergencies, and to increase the intelligence and consequent enjoyment with which men engage in their pursuits.

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SCIENTIFIC TRACTS.

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NORTHWEST PASSAGE.

Ever since the discovery of America, efforts have been made to find some western, or northwestern passage to India. The present passage is long and tedious. The ship which leaves the mouth of the Thames, must traverse a distance of 16,500 miles, before it enters the port of Canton. A westerly route would diminish the distance more than one half, and if a ship could sail directly over the north pole, the distance from London to Canton; would be but about 7,774 miles. Consequently immense commercial advantages would arise from the discovery of any such passage. Ever since the new world rose to view, the eyes of almost every civilized nation have been directed to this object. At first the easterly shore of the American coast was explored, with the hope that some strait would be found, communicating the waters of the Atlantic to the Pacific. For a time there was sanguine hope that the gulf of Mexico opened the much desired passage; but these hopes were soon dashed, by the discovery of a rocky chain of mountains, separating the waters of the two oceans, and defying every effort of the Atlantic and Pacific wave to meet. Every crook and inlet in the American coast, was afterwards explored, till the continuity of land from the gulf of Mexico, to the arctic circle was fully ascertained. All hopes of a direct westerly passage being thus cut off, the question then remained, can any passage be found, around the northern shores, of the American continent?

The present object is therefore to discover a 'Northwest Passage' to India. The history of hardly any enterprise on earth is more replete with scenes of boldness and of peril. There is something heart stirring in the thought of a frail ship, toiling its way amid mountains of ice, and riding upon that stormy ocean, when it is hourly in danger of being crushed like an egg shell, by the ice Islands driven by the tempests around it. But all the dangers of the polar seas, have been braved with an enthusiasm which is truly astonishing. In this enterprise England has taken the lead; and her seamen in contending with the tempests and snows of the north, have displayed a naval energy, a spirit of adventure, a hardihood and endurance of suffering, which has been surpassed by no other people.

Mr Frobisher (afterwards Sir Martin) was the first Englishman who undertook the discovery of a northwest passage to India. The plan of the expedition, originated with himself, and after spending fifteen years in soliciting the means of equipping two little barks, he spread his sails in 1576 to face the tempests of the Arctic ocean. He made three voyages, all of which were so unsuccessful, that it served to dampen instead of encourage, the spirit of enterprise in this quarter. A singular series of disasters accompanied his efforts. He returned to Britain with his ships greatly shattered by furious blows from the masses of floating ice, by which his progress was obstructed, and in which not unfrequently his vessels were firmly wedged. The effect of this disappointment however soon passed from the public mind, and in 1585, an association of gentlemen prepared another expedition for effecting the discovery of the northwest passage, and entrusted it to the command of Mr John Davis. He also made three successive voyages. The results however were not much more satisfactory than those which attended the efforts of his predecessor. He discovered the broad strait which now bears his name, and having penetrated it to what he considered its widest expanse, brought back word that there appeared an open sea, stretching to the westward. He was very sanguine in his hopes that this open sea would prove the long desired passage.

But the patience of patrons being exhausted by three failures, they refused to listen to his earnest solicitation for a fourth equipment. Davis proceeded as high as the 73° lat.

Again in 1607, a society of merchants engaged Capt. Henry Hudson, a man of daring intrepidity, and great boldness, to go in search of some northern route to India and China. He first sought a passage by the east, along the north coast of Asia. Having advanced as high as 32° N. he was obstructed by mountains and fields of ice, and was compelled to relinquish that design. He then made a daring attempt to pass, by a route between the islands of Spitzbergen and Nova Zembla, directly across the pole itself. This attempt also failed. But few of the particulars of this voyage have been made public. He then tried the old route by the west. From this voyage he never returned. Having passed the straits which now bear his name, he entered the great sea called from him Hudson's bay, and took up his winter quarters in the most southerly point of the bay, intending again to weigh anchor early in the spring, and proceed in his voyage of discoveries. The crew however, impelled to mutiny by one Green, whom he had rescued from destruction, forced Hudson, his son and seven others into a boat and turned them adrift, amid fields of ice, to bear as they could the storms and the snows of that frozen deep; unseen and unheard he perished. Many of the mutineers perished miserably by the hands of the savages. The rest of the crew returned to England, in a state of extreme wretchedness, and asserted, though they did not satisfy the world, that they were the innocent and reluctant spectators of the mutiny.

Undismayed by these failures, and encouraged by the discovery of Hudson's bay, these enterprising adventurers, in the following year, sent Sir Thomas Button to explore this new sea, improperly called a bay. Soon the sails of Sir Thomas were unfurled to the breezes, which played over those northern waters. He pushed boldly across their broad expanse, and was rejoicing in the belief that he was in full career to the Pacific, when his hopes were suddenly dashed, by the appearance of a long un-

broken barrier of coast, forbidding further advances. He appropriately named this barren region 'Hope checked,' and returned dejected to his country.

Frustrated on this side, a new expedition was prepared to penetrate the sea entered by Davis, of which no limit had yet been reached. The command of this expedition was entrusted to Baffin. In 1616, he entered Davis's strait, and made the complete circuit of that sea, which from this circumstance has received the name of Baffin's Bay. It is not however wonderful that in this circuit he passed by Lancaster sound without being aware that it was anything more than a small arm of the sea. Having very cursorily examined this opening, he returned to Britain with the decided impression, that the long sought for passage had no existence.

This conclusion for a time seemed to be acquiesced in by the British public. In the meantime similar efforts were made by other nations, but with still less success. The Spaniards fitted out several expeditions from Mexico and sailed along the western shores of North America; but they were never able to reach beyond the dreary coast of California.

In 1630, Lucus Foxe, a shrewd and sensible man, who quaintly styled himself the 'Northwest Foxe,' in some degree revived the spirit of adventure, and was entrusted with the command of a new expedition. After winding a toilsome way through mountains and fields of ice, and contending with adverse winds and freezing tempests, he concluded that he must either 'seek a harbor or freeze to death in the sea,' and therefore returned to England without making any addition to previous discoveries.

About this time the Hudson Bay company was formed, for trafficking in furs, with which this dreary region of the north abounded. In the charter which gave them the monopoly of this trade, they were bound to use their utmost efforts for the discovery of the northwest passage. It has, however, been confidentially asserted, that they, fearing that the discovery of such a passage would deprive them of their monolopy, did all in their power to repress curiosity and discourage enterprise upon this subject. They endeavored to impress the public

with the idea, that all hopes of finding such a passage were utterly futile.

The government of England, however, persevered in the prosecution of new discoveries. In 1777, the celebrated navigator Capt. Cook, was sent to coast along the western shore of America, and ascertain the relative situation of the two continents. He passed through Berhing's straits, from which he saw both Asia and America. The width of the strait dividing the two continents he thought to be about 42 miles. This discovery gave entirely a new aspect to this subject. Hitherto it had been supposed that the northern shore of America terminated almost in a point, and that the distance from the Atlantic to the Pacific, must be very small. But now from the longitude of the Eastern and the Western Cape, it was ascertained that the continent in that part was *three thousand miles wide*, a long, long distance to pass through the eternal snows of that stormy region. The idea that the Atlantic and Pacific waters could there flow together, was then almost relinquished, and geographers constructed their maps under the impression, that an unbroken mass of land extended to the pole, and that these boundaries were forever barred against the navigator.

An accidental discovery however again reanimated hope. Mr Hearne, an agent of the Hudson Bay company, while following northward the course of the river, now bearing his name, came very unexpectedly to the open sea. As far as the eye could range, the wide rolling ocean extended. Sir Alexander Mackenzie, an agent of the northwest company at Montreal, followed the northerly flow of a river about 1,200 miles farther west till he also came to a sea. These two discoveries gave entirely a new aspect to the geography of Northern America. It now became probable that a continuous ocean bounded the continent on the north, instead of unbroken land, stretching into the depth of the polar regions. Hope was again excited, that an open passage might be found communicating the Atlantic and the Pacific, through which there might be free and easy navigation.

These important observations did not produce immedi-

a e action. For some time they remained dormant in the public mind, till early in this century, they gave a new impulse, which has resulted in a most splendid carreer of naval enterprises.

The first expedition was entrusted to the command of Capt. John Ross, an officer who had already distinguished himself by valuable services in the northern seas, but seemed hardly possessed of that bold adventurous spirit which is requisite for one who would push his way amid the mighty barriers of the arctic deep. He was commissioned to make the circuit of Baffin's Bay, and narrowly examine every sound and inlet, which could afford a passage to the Pacific. In navigating these dangerous seas he displayed great skill in seaman-ship. It is difficult for us when seated by our own firesides, to form any adequate idea, of the dark and dismal storms, which howl over those ice bound waters. The following is a description of one of these scenes of danger. 'As the gale increased the ice began to move with greater velocity, while the continued thick fall of snow, kept from our sight the further danger that awaited us, till it became imminent; a large field of ice was soon discovered at a small distance, bearing fast down upon us from the west, and it thus became necessary to saw docks for refuge, in which service all hands were immediately employed. It was however found too thick for our nine feet saws, and no progress could be made. This circumstance proved fortunate, for it was soon after perceived, that the field to which we were moored for this purpose, was drifting rapidly on a field of icebergs which lay aground; the topsails were therefore close reefed, in order that we might run, as a last resource, between two bergs, or into any crook that might be found among them; when suddenly the field acquired a circular motion, so that every exertion was necessary for the purpose of working along the edge, that being the sole chance we had of escaping the danger of being crushed on an ice-berg. In a few minutes we observed that part of the field into which we had attempted to cut our docks, come in contact with the berg with such rapidity and violence, as to rise more than fifty feet up its precipitous side, when it suddenly

broke, the elevated part falling back upon the rest, with a terrible crash, and overwhelming with its ruins, the very spot we had previously chosen for our safety. Soon afterwards the ice appeared sufficiently open for us to pass the reef of bergs, and we once more found ourselves in a place of security.

On the 24th of August the sun was observed to set for the first time since the 7th of June, 'thus terminating a day, which consisted of one thousand eight hundred and seventytwo hours, and giving us a warning of the approach of a long and dreary winter.'

Capt. Ross, after imperfectly examining the several inlets of this Bay, returned to England. His report was exceedingly unsatisfactory to his employers. Lancaster sound which Baffin discovered, but had not explored, and which was regarded as the most probable passage to the Pacific, was very imperfectly examined by Ross. He sailed into the bay some distance, till he thought he saw the land meet at the bottom of the bay, and then tacked about and left it. Some of the officers associated with him still believed that Lancaster sound would present the long looked for opening. Such was very decidedly the impression of Capt. Parry, the second in command.

Immediately a new expedition was fitted out to explore Lancaster sound. Capt. Parry was appointed commander. On the 4th of May, 1819, Capt. Parry, with two ships, ommenced his voyage. The 3d of July they crossed the arctic circle, surrounded by numerous icebergs of huge dimensions, and immense masses of floating ice, which a heavy wind dashed together with tremendous force. 'The force of the winds and waves sometimes raised a white spray over them to the height of more than one hundred feet, and being accompanied with a loud noise, exactly resembling the roar of distant thunder, presented a scene at once sublime and terrific.' The central part of Davis's Strait and Baffin's Bay, he found filled with ice, and after many ineffectual efforts to pass around it or find some opening he was compelled boldly to force his ships into the midst of this fearful barrier, in hopes of finding clear water beyond. The breadth of the ice was found to be about eighty miles. By almost incredible exertions

they succeeded in forcing their way through, at the rate of about twelve miles a day, or half a mile an hour. On the seventh day after entering it, they happily succeeded in reaching the open water, and were gratified to find that they could now enter the sound without any impediment.

With a fine breeze and a crowd of sail, they were borne rapidly to the westward, and with the most intense interest, they sailed along the sound or inlet, so celebrated for the different views entertained respecting its termination and extent. 'It is more easy to imagine than describe, the almost breathless anxiety, which was now visible, in every countenance, while as the breeze increased to a fresh gale, we ran quickly up the sound. The mast heads were crowded by the officers and men during the whole afternoon; and an unconcerned observer, if any could have been unconcerned, on such an occasion, would have been amused by the eagerness with which the various reports from the crow's nest were received, all however hitherto favorable to our most sanguine hopes.' 'Before midnight they were pretty well relieved from all anxiety respecting the alleged continuity of land round the supposed extremity of this magnificent inlet, and fully convinced that the intrepid assertions, descriptions and paintings, the produce of the preceding voyage, were wholly gratuitous; in this they could not be deceived, for the weather being remarkably clear, and the ships having reached the longitude of 83° 12′, the two shores of the passage were observed to continue full fifty miles apart, and not a vestige of land could be discovered to the west.' In fact neither mountain or ice, or other obstacle, real or imaginary, opposed the progress of Capt. Parry.

The expedition proceeded rapidly along this bay, without obstruction. The sea was as free from ice as any part of the Atlantic. With 170 fathoms of line they could find no bottom, and in the direction of their course no land was in sight. Their hopes were most sanguine that they were in full sail for the Pacific. Says Capt. Parry, 'We began to flatter ourselves that we had fairly entered the Polar Sea, and some of the most sanguine among us

had even calculated the bearing and distance of Icy Cape as a matter of no very difficult or improbable accomplishment. This pleasing prospect was rendered the more flattering, by the sea having as we thought, gained the usual oceanic color, and by a long swell which was rolling in from the southward and eastward.'

Soon however they were alarmed by the appearance of land ahead; and though this proved to be but a small island, an impassable barrier of ice extended from it to the northern shore of the strait. A large opening extended down the southern shore into which Parry entered. For several days he sailed through an open sea in a southerly direction, till he was arrested by solid ice stretching farther than the eye could reach. Capt. Parry says, 'I think it will appear highly probable that a communication will one day be found to exist between this inlet and Hudson's Bay, either through the broad and unexplored channel, called Sir Thomas Row's Welcome, or through Repulse Bay, which has not yet been satisfactorily examined.' This inlet has received from him the name of Prince Regent's Inlet, and as such may be found laid down upon recent maps.

Turning about, he retraced his steps to the mouth of the bay, but owing to contrary winds, storms, ice, snow and fog, it was ten days before they returned to the strait. Here however they found that the ice had moved away, and a clear sea invited them onward in their western course. The strait thus far appeared about 50 miles in breadth, and they felt constantly uneasy for fear the northern shore might take a turn to the south and unite with the American coast. A magnificent opening in the northern shore, 24 miles in width, soon dispelled these fears, and all on board felt that they had actually entered the Polar Sea. Winter was now rapidly setting in. The passage was studded with islands, and shoals, dark fogs, and floes* of ice; thus rendering navigation exceedingly slow and hazardous.

* A wide expanse of Ice is called a *field*; one of smaller dimensions a *floe*.
When a field of ice is broken into numerous pieces of 40 or 50 yards' diameter, they collectively are termed a *pack*. These packs

These islands were of moderate height, but not a living creature of any description was found upon them. As they proceeded the channel became more and more obstructed by islands and by ice. The weather became daily worse; the sun being obscured by dense fogs, the nights dark and excessively cold. By the 4th of Sept. they had passed the meridian of 110° west lon. which entitled them to a reward of five thousand pounds, voted by the British Parliament to those who should first sail to that point.

Winter now set in, in good earnest; an impenetrable barrier of ice prevented their farther progress, and nothing remained but to select their winter quarters. Some idea may be formed of the peril of their situation from what follows. 'We now seemed rather to have got within the drift of the main body of ice, which passed us to the westward at the rate of two miles an hour; but at length the point of a large field, which had hitherto not approached the shore nearer than two or three hundred yards, was observed to be rapidly nearing us. Immediately to the westward of the spot where the Heckla's anchor had been dropped, some very heavy ice, which for distinction' sake we called a berg, projected from the beach to the distance of a hundred and fifty yards. The ship had been fortunately forced by the ice, on one side of this projecting point, for at 8, P. M. the field came in contact with a tremendous crash, piling up the enormous fragments of ice in the most awful and terrific manner; this seemed to break in some degree the force with which the ice had been driving; a force which may almost be considered incalculable, as we could not see over the field in motion, from our mast head. We were at this time within a hundred yards of the point, and had therefore great reason to be thankful for having escaped being car-

are crowded together by a heavy wind, and separate and spread asunder in a calm.

If a ship can sail freely through floating pieces of ice it is called *drift ice*.

When the ice is ground into minute fragments it is called *brack ice*. A portion of ice rising above the common level is termed a *hummock*.

An iceberg is an immense mountain of ice floating on the ocean.

ried into a situation in which no human power or skill could have saved the ship from instant destruction.' With the greatest exertion they succeeded in sawing their way, through thick and firm ice, into a harbor on Melville Island. The ice formed around them with such astonishing rapidity, that before they had placed their ships in their winter stations, the sea was frozen over as far as the eye could reach, and not one speck of water could be seen. Here they made preparation, for the long dark and dreary winter before them. 'The first operation, after removing all the heavy stores and timber on shore, in order to have a clear deck for exercise, was to house the ships entirely over, and to cover the roof with a thick wadding tilt, such as is used for covering wagons; to bank up the snow as high as the main chains; and to provide for the warmth and dryness of the berths, by means of an oven and stove pipe. On the 5th of Nov. the sun sank below the horizon, not to make its appearance again for three tedious months. The thermometer was generally 30, 40, and sometimes even 50° below zero.' This degree of cold would allow them to go out into the open air if there was no wind. If there was any wind exposure was intolerable. This long and bleak winter must have been dreary in the extreme. Some faint idea of the tedious monotony which was daily presented may be gathered from the following description. 'To the southward was a sea covered with one unbroken surface of ice, uniform in its dazzling whiteness, except that in some parts a few hummocks were seen thrown up somewhat above the general level. Nor did the land afford much greater variety, being almost entirely covered with snow, except here and there a brown patch of bare ground, in some exposed situation where the wind had not allowed the snow to remain. When viewed from the summit of the neighboring hills, on one of those calm and clear days, which not unfrequently occurred during the winter, the scene was such as to induce contemplations, which had perhaps more of melancholy than of any other feeling; not an object was to be seen, on which the eye could long rest with pleasure, unless when directed to the spot where the ships lay and where our

little colony was planted. The smoke which then issued from the several fires, affording a certain indication of the presence of man, gave a partial cheerfulness to this part of the prospect, and the sound of voices, which during the cold weather could be heard at a much greater distance than usual, served now and then to break the silence, which reigned around us; a silence far different from that peaceful composure which characterises the landscape of a cultivated country; it was the death-like stillness of the most dreary desolation, and the total absence of animated existence. Such indeed was the want of objects to afford relief to the eye, or amusement to the mind, that a stone of more than usual size appearing above the snow, in the direction to which we were going, immediately became a mark, on which our eyes were unconsciously fixed, and towards which we mechanically advanced. Dreary as such a scene must necessarily be, it could not be said to be wholly wanting in interest; especially when associated in the mind with the peculiarity of our situation; the object which had brought us hither, and the hopes which the least sanguine among us sometimes entertained, of spending a part of our next winter in the more genial climate of the South sea Islands. Perhaps, too, though none of us ventured to confess it, our thoughts would sometimes involuntarily wander homewards, and institute a comparison between the rugged face of nature in this desolate region, and the livelier aspect of the happy land we had left behind us.'

On the 7th of Feb. the sun displayed for the first time since the 5th of November his full orb above the horizon. Still the ships were held in icy chains which it would require many months to loosen. It was not till the first of August that they were able to escape from winter harbor. Then the vast quantities of ice floating about them frequently threatened them with immediate destruction. The ice was found to be more heavy, the farther they advanced westerly. All their efforts to force their way through the ice, which was wedged among the westerly islands, proved ineffectual. After having encountered innumerable perils, they were reluctantly compelled to

turn their faces homewards. A fair breeze soon took them from the strait into Baffin's Bay, and they returned to England with the glory of having advanced farther westward, than any had gone before them. The farthest point of west longitude they reached, was 113° 46'.

The polar sea having been thus discovered, a new voyage was planned, with the view of entering it by a different approach. Hudson's Bay had not as yet been carefully explored. Parry, who had acquired a very high reputation, by the skill with which he had conducted the last expedition, was sent out, to explore the sounds and inlets of this bay. They passed another winter in the northern part of this bay, exposed to the rigor of arctic storms. In the summer, proceeding northward, they arrived at a strait, so blocked up by ice, forced into it by a westerly current, that all attempts to enter it were in vain. By land survey, however, they ascertained that this strait led into the polar. This strait being at all times filled with ice, was useless for purposes of navigation, and the discovery though interesting in extending geographical knowledge, afforded no facilities for commerce.

A third voyage was undertaken, but one of his ships being crushed by the ice, they were compelled to abandon it, and return without having accomplished anything in the other.

At the same time Capt. Parry made his second voyage, an expedition was sent by land, to find the northern shore of America, and sail along its coast, with the hopes of meeting Capt. Parry. Capt. Franklin, who was entrusted with the command of this expedition, passed the winter on the northern lakes of America, and early in the summer passed down the Coppermine River, and spread the first sail on the Arctic Ocean, which bounds northern America. They met innumerable obstructions in exploring this unknown sea. After they had advanced about two hundred miles from the spot on which they had first launched, the lateness of the season compelled them to turn back. As their provisions were scanty they endeavored to strike across the country, to their winter quarters on the Athabasea lake. But entangled by mountains, torrents and lakes, they endured the most awful sufferings.

Undismayed by discomfiture and suffering, a new plan was presented. Capt. Franklin and Dr Richardson, were to descend the Makenzie River, and thence diverge in opposite directions. The former to force his way westerly towards Icy cape, near which he was to expect Capt. Beechy with the ship Blossom prepared to meet him. The latter, was to proceed eastward to the mouth of the Coppermine River, the western limit of Franklin's late expedition. The party proceeded by the way of New York up the Hudson and along the lakes to Makenzie River. Having passed a severe winter in these cold latitudes, early in June they descended the river, and commenced their separate routes. The shores were encumbered with ice, and continually darkened with heavy fogs. Navigation was slow, toilsome, and dangerous. The sixteenth of August had arrived, before Capt. Franklin had passed one half the distance to Kotzebue's Inlet where he was expecting to meet Capt. Beechy. 'Yet symptoms of approaching winter were already perceived. The sun set at eleven o'clock — thick ice was formed during the night, and the flocks of geese commenced their autumnal flight to the southward.' They were therefore compelled to turn back, it was however afterwards ascertained that they had arrived within 160 miles of a boat sent by Capt. Beechy from the Blossom to meet them. Had Capt. Franklin at the time known this, he would in defiance of all obstacles, have forced his way onwards. But not knowing this fact, it would have been inexcusable rashness not to have turned back. Dr Richardson was more successful. He passed along the line of coast assigned to him, and entering the Coppermine River, ascended to the shores of Bear Lake, where he was met by boats which conveyed him to winter quarters.

Such was the result of this enterprise. There is nothing in the detail particularly interesting. 'The character of these shores is marked by a vast and dreary monotony. There is little to distinguish one from another, among the range of naked and frozen lakes, and ice encumbered inlets, through which the expedition was doomed to wind its toilsome and perilous way.'

The following is a description of some of their perils.

'As the afternoon wore away, gloomy clouds gathered in the northwest, and at six a violent squall came from that quarter, attended with snow and sleet. The gale increased with rapidity; in less than ten minutes the sea was white with foam, and such waves were raised as I had never before been exposed to in a boat. The spray and sea broke over us incessantly, and it was with difficulty that we could keep free by bailing. Our little vessels went through the water with great velocity under a close reefed sail, twisted about three feet up the mainmast, and proved themselves to be very buoyant. Their small size however, and the nature of their construction, necessarily adapted for the navigation of shallow rivers, unfitting them for withstanding the sea then running, we were in imminent danger of foundering. I therefore resolved on making for the shore, as the only means of saving the party, although I was aware that in so doing, I incurred the hazard of staving the boats; there being few places on this part of the coast, where there was sufficient beach under the broken cliffs. The wind blowing along the land, we could not venture on exposing the boats side to the sea, by hauling directly in. But edging away with the wind in that quarter, we most providentially took the ground in a favorable spot. The boats were instantly filled with the surf, but they were unloaded and dragged up without having sustained any material damage. Impressed with a sense of gratitude for the signal deliverance we had experienced on this and other occasions we assembled in the evening to offer up praise and thanksgiving to the Almighty.' The distance of the coast traced westward from the mouth of Makenzie River, by Capt. Franklin was about 374 miles. The distance from the Makenzie to the Coppermine is about 500 miles. The winding route however, which Dr Richardson was compelled to take, made about 900. The whole amount of coast explored by these enterprising navigators, is very considerable, but a small part of the coast now remains to be examined.

Another enterprise was now undertaken even more daring than any of the preceding. Capt. Parry, with characteristic boldness, undertook the command of an ex-

pedition to go direct to the north pole. He was to go as far as possible by water, and when the ice should present a solid barrier, to travel forward on foot, with a select band of hardy men. Capt. Parry set out on this expedition.

They had two sledge boats so constructed, as either to be drawn over the ice or sail through the water. 'Let but any one conceive for a moment, the situation of two open boats, laden with 70 days' provision and clothing for 28 men in the midst of the sea, covered nearly with detached masses and floes of ice, over which these boats were to be dragged, sometimes up one side of a rugged mass and down the other; sometimes across the lanes of water that separated them; frequently over a surface covered with deep snow, or through pools of water; let him bear in mind that the men had little or no chance of any other supply of provisions than what they carried with them, calculated as just sufficient to sustain life — and consider what their situation would have been in the event, by no means an improbable one, of losing any part of their scanty stock; let him also recollect that they were exposed to all the vicissitudes of a climate, whose temperature did not much exceed and was sometimes below the freezing point, in the midst of heavy rains and snow, in which, for forty days or more, out of the sixtythree passed in this manner, nothing was visible all around but the sea, thus covered with these struggling masses of ice, and overhead a murky sky — let but one try to imagine to himself a situation of this kind, and he will still have but a faint idea of the exertions which the men under Capt. Parry had to make, and the sufferings and the privations they had to undergo. That under such circumstances and privations the expedition should have failed, is less wonderful than that it should have returned with every officer and man, in nearly as good a state of health as when the adventurous band quitted their ship and took to the boats. There is something in the failures of Capt. Parry that compensates the want of success and reconciles us to the disappointment.' Early in the month of April Capt. Parry sailed from England. On he 14th of May the ship was driven into the main body

of ice. For 24 days they were unable to extricate themselves. The 19th of June they anchored their ship (the Hecklà) in a bay on the north coast of Spitzbergen.

The 21st of June Capt. Parry set out from the Heckla, with two boats, on his perilous enterprise. He directed his course through fields of drift ice, till he came to the solid and main body, when drawing their boats upon the ice, the men toiled along their dreary way on foot. When arriving at any chasm in the ice, they crossed it in their boats, and again resumed their journey. The following is a description of the manner in which this daring party pursued their way, through the darkness, and the freezing storms around them.

'Our plan of travelling being nearly the same throughout this excursion after we first entered upon the ice, I may at once give some account of our usual mode of proceeding. It was my intention to travel wholly at night, and rest by day, there being of course, constant daylight in these regions during the summer season. The advantages of this plan, which was occasionally deranged by circumstances, consisted first, in our avoiding the intense and oppressive glare from the snow during the time of the sun's greatest altitude, so as to prevent, in some degree, the painful inflammation in the eyes, called "snow blindness," which is common in all snowy countries. We also thus enjoyed greater warmth during the hours of rest, and had a better chance of drying our clothes; besides which, no small advantage was derived from the snow being harder at night for travelling. The only disadvantage of this plan was that the fogs were somewhat more frequent and more thick by night than by day, though even in this respect there was less difference than might have been supposed, the temperature during the twentyfour hours undergoing but little variation. This travelling by night and sleeping by day so completely inverted the natural order of things, that it was difficult to persuade ourselves of the reality. Even the officers and myself, who were all furnished with pocket chronometers, could not always bear in mind at what part of the twentyfour hours we had arrived; and there were several of the men who declared, and I believe truly, that they never

knew night from day during the whole excursion. When we rose in the evening, we commenced our day by prayers, after which we took off our fur sleeping dresses, and put on those for travelling; the former being made of camlet, lined with racoon-skin, and the latter of strong blue box cloth. We made a point of always putting on the same stockings and boots for travelling in, whether they had dried during the day or not; and I believe it was only in five or six instances, at the most, that they were not either still wet or hard frozen. This indeed, was of no consequence, beyond the discomfort of first putting them on in this state, as they were sure to be thoroughly wet in a quarter of an hour after commencing our journey; while on the other hand, it was of vital importance to keep dry things for sleeping in. Being rigged for travelling, we breakfasted upon warm cocoa and biscuit, and after storing the things in the boats and on the sledges, so as to secure them, as much as possible, from wet, we set off on our day's journey and usually travelled from five to five and a half hours, then stopped an hour to dine, and again travelled four, five, or even six hours, according to circumstances. After this we halted for the night, as we called it, though it was usually early in the morning, selecting the largest surface of ice we happened to be near, for hauling the boats on, in order to avoid the danger of its breaking up by coming in contact with other masses, and also to prevent drift as much as possible. The boats were placed close alongside each other, with their sterns to the wind, the snow or wet cleared out of them, and the sails, supported by the bamboo masts and three paddles placed over them as awnings, an entrance being left at the bow. Every man then immediately put on dry stockings and fur boots, after which we set about the necessary repairs of boats, sledges, or clothes; and after serving the provisions for the succeeding day we went to supper. Most of the officers and men then smoked their pipes, which served to dry the boats and awnings very much, and usually raised the temperature of our lodgings 10 or 15°. This part of the twentyfour hours was often a time, and the only one, of real enjoyment to us; the men told their stories, and "fought all

their battles over again," and the labors of the day, unsuccessful as they too often were, were forgotten. A regular watch was set during our resting time, to look out for bears or for the ice breaking up around us, as well as to attend to the drying of the clothes, each man alternately taking this duty for one hour. We then concluded our day with prayers, and having put on our fur dresses, lay down to sleep with a degree of comfort which perhaps few persons would imagine possible under such circumstances; our chief inconvenience being, that we were somewhat pinched for room, and therefore obliged to stow rather closer than was quite agreeable. The temperature, while we slept was usually from 36 to 45° according to the state of the external atmosphere; but on one or two occasions in calm and warm weather, it rose as high as 60 to 66°, obliging us to throw off a part of our fur dress. After we had slept seven hours, the man appointed to boil the cocoa roused us, when it was ready, by the sound of a bugle, when we commenced our day in the manner before described. Our allowance of provisions for each man per day was as follows:

Biscuit	10 ounces.	
Pemmican	9 "	
Sweetened cocoa powder	1 "	to make a pint.
Rum	1 gill.	
Tobacco	3 ounces per week.	

Our fuel consisted entirely of spirits of wine, of which two pints formed our daily allowance, the cocoa being cooked in an iron boiler over a shallow iron lamp, with seven wicks, a simple apparatus, which answered our purpose remarkably well. We usually found one pint of the spirits of wine sufficient for preparing our breakfast, that is, for heating twentyeight pints of water, though it always commenced from the temperature of 32°. If the weather was calm and fair, this quantity of fuel brought it to the boiling point in about an hour and a quarter; but more generally the wicks began to go out before it had reached 200°. This however, made a very comfortable meal to persons situated, as we were. Such, with very little variation, was our regular routine during the

whole of this excursion. As soon as we landed on a floe piece, Lieutenant Ross and myself generally went on ahead, while the boats were unloading and hauling up in order to select the easiest road for them. The sledges then followed in our track, Messrs Beverly and Bird accompanying them; by which the snow was much trodden down, and the road thus improved for the boats. As soon as we arrived at the other end of the floe, or came to any difficult place, we mounted one of the highest hummocks of ice near at hand, (many of which were from fifteen to five and twenty feet above the sea) in order to obtain a better view around us; and nothing could well exceed the dreariness which such a view presented. The eye wearied itself in vain to find an object but ice and sky to rest upon; and even the latter was often hid from our view by the dense and dismal fogs which so generally prevailed. For want of variety, the most trifling circumstance engaged a more than ordinary share of our attention; a passing gull, or a mass of ice of unusual form became objects which our situation and circumstances magnified into ridiculous importance; and we have since often smiled to remember the eager interest with which we regarded many insignificant occurrences. It may well be imagined then, how cheering it was to turn from this scene of inanimate desolation to our two little boats in the distance, to see the moving figures of our men winding with their sledges among the hummocks, and to hear once more the sound of human voices breaking the stillness of this icy wilderness. In some cases Lieutenant Ross and myself took separate routes to try the ground, which kept us almost continually floundering among deep snow and water. The sledges having then been brought up as far as we had explored, we all went back for the boats; each boat's crew, when the road was tolerable, dragging their own, and the officers laboring equally hard with the men. It was thus that we proceeded for nine miles out of every ten that we travelled over ice; for it was very rarely indeed that we met with a surface sufficiently level and hard to drag all our loads at one journey and in a great many instances, during the first fortnight, we had to make three journeys

with the boats and baggage — that is, to traverse the same road five times over.'

The obstacles which this party met and overcome would by most persons have been deemed insurmountable. Their path was over rough and rugged masses of ice, hauling their boats up one precipice and lowering them down the other side — sometimes up to the middle in half melted snow, and sometimes dragging their boats through wide but shallow pools of water. Sometimes they found the surface for many miles covered with deep snow through which they had to wade dragging their heavy burdens. Sharp crystallized ice cut their boots and feet and lying in loose and moveable fragments, rendered walking slow and fatiguing. In all cases, the y were compelled to travel over the same floe several times to bring up the boats, sledges and provisions. Frequently the extreme strength of the whole party was requisite to drag one boat along some rugged track. Sometimes they were compelled to draw up their boats almost perpendicularly over precipitous ice. In addition to this they were exposed to driving tempests of snow and drenching storms of rain. At one time the rain continued pouring without intermission for 24 hours, keeping them thoroughly drenched to the skin. This was followed by dense fogs rendering their way still more dark and gloomy. In consequence of these obstructions, it is not strange that their progress was exceedingly slow. Frequently they advanced only two, sometimes three and seldom more than four or five miles, in the course of a day. At one time they were laboring hard for two hours and a half in advancing one hundred and fifty yards. It was soon found that all their toil was in vain, for the body of ice upon which they were travelling was drifting to the south about as fast as they were advancing to the north. At one time after taking the meridian altitude, they travelled ten or eleven miles due north, and then were mortified in finding that they had lost by drift, more than thirteen miles and a half, and were no less than three miles *southward* of their last observation. And again after travelling twentythree miles in a northerly direction, they were drifted back so fast by the ice, that

they found by observation that they had gained but one mile due north. They were now struggling against a southerly drift exceeding four miles a day, and it became perfectly hopeless to pursue the journey farther. The highest point of latitude that was reached by Capt. Parry was 82° 45′, the meridian of 19° 25′ east of Greenwich. He says, 'at the extreme point of our journey our distance from the Heckla, was only one hundred and seventy-two miles, in a south-southwest direction. To accomplish this distance we had traversed, by our reckoning two hundred and ninetytwo miles, of which about one hundred were performed by water previously to our entering the ice. As we travelled by far the greater part of our distance on the ice three and not unfrequently five times over, we may safely multiply the length of the road by two and a half, that our whole distance on a very moderate calculation amounted to five hundred and eighty geographical or six hundred sixtyeight statute miles, being nearly sufficient to have reached the pole in a direct line. Up to this period we had been particularly fortunate in the preservation of our health, neithersickness nor casualty having occurred among us with the exception of the trifling accidents already mentioned, a few bowel complaints, which were soon removed by care, and some rather troublesome cases of chilblains, arising from our exposure to wet and cold.'

Capt. Parry, finding that all efforts to advance beyond that point were fruitless, was compelled with very great reluctance to relinquish the farther prosecution of the enterprise, and turn his face homewards. He says, 'had our success been at all proportionate to our exertions, it was my full intention to have proceeded a few days beyond the middle of the period, for which we were provided, trusting to the resourçes we expected to find at Tuble island. But this was so far from being the case, that I could not but consider it as incurring useless fatigue to the officers and men, and unnecessary wear and tear for the boats, to persevere any longer in the attempt. I determined therefore on giving the people one entire day's rest, which they very much needed, and time to wash and mend their clothes, while the officers were oc-

cupied in making all the observations which might be interesting in this latitude; and then to set out on our return on the following day. Having communicated my intentions to the people, who were all much disappointed in finding how little their labors had effected, we set about our respective occupations, and were much favored by a remarkably fine day.'

In the afternoon of the 27th of July the party commenced their homeward journey and observes Capt. Parry, 'I can safely say that dreary and cheerless as were the scenes we were about to leave, we never turned homewards with so little satisfaction as on this occasion.' In 14 days they arrived at the open sea, and heard the roar of the ocean, dashing with heavy surges against the outer masses of ice. Leaving the ice after having sojourned upon it 48 days, they spread their sails, and steering through dense fogs, and storms of snow, in ten days they were cheered with loud huzzas by their shipmates on board the Heckla, after an absence of *sixtyone days*.

Such was the result of this adventurous enterprise, conducted with consummate skill, and failing in consequence of obstacles which no human prudence could have foreseen, and no skill or perseverance have surmounted. The question is now agitated in England, whether it be best to fit out another expedition to the pole. By some it is supposed, that the result of the last expedition has proved that every attempt to reach the pole must be unavailing. By others it is supposed that by undertaking it at a different season of the year or by proceeding upon a different meridian the enterprise may be achieved. It is not improbable that ere long the attempt may be made. By these enterprises undeniable proof has been obtained that the great Continent of America is insulated, and that the Arctic ocean dashes along its northern shore. It is as yet by no means certain that a passage may not be found open to safe navigation. Says an English reviewer, 'we think we may conclude with Parry and Franklin, that though the object for which these voyages were undertaken has not been fully accomplished, yet a northwest passage is feasible, and that it will one day be made

if not by us, by our rival Brother Jonathan, who we are inclined to think, will not find it very difficult, with a wind and current in his favor, to run in one season from Icy Cape, through Prince Regent's Inlet and Lancaster Sound, into Hudson's Bay.'

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SCIENTIFIC TRACTS.

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LIFE AND CHARACTER OF ROBERT FULTON.

The biography of an individual so eminently distinguished as Fulton was in the noblest inventions and improvements which have characterized the present age, cannot be a matter of indifference to any one of his countymen. The application of steam to the navigation of vessels — if this were his only memorable achievement — must be alone, as it should be, sufficient to render his name immortal. Its effects have been practical and universal. They are felt to this day; and upon every stream, and every harbor in this country; and they cannot but continue to be thus felt as long as the rivers themselves shall flow. Already, indeed, the vast current of the Mississippi is stemmed by a hundred steamboats. The ends of the American continent have been brought together. New cities, new trades, new branches of commerce have arisen from the increased facilities of communication and transportation; and the amount of wealth added to the common stock of the country in one way or another — including the creation of new employments, the vast saving of time in travelling and trading, and the immense markets for reciprocal commerce opened between different and distant sections, is absolutely incalculable.

It would not indeed be just to assert that all this is to be attributed, strictly, to the genius of Fulton alone. It would be unjust to the fame of others, as well as unneces-

sary to his, to forget either the labors of his predecessors in science and art of which he availed himself, or the subsequent and not inconsiderable improvements, on the other hand, which have been made upon his own labors. But Fulton after all, must have the credit of completing a grand discovery, which was only the more honorable to him — as it was proved to be the more difficult — because men of the character of Savary, and Beighton, and Watt, and Franklin himself had been at work upon it in vain for ages.

It will be an object with us in the following pages, besides gratifying the curiosity which is naturally felt respecting the mere life of this successful individual, to point out directly the causes of his success, and of course indirectly the causes of the failure of others. It will be seen, if we mistake not, that though genius did something for him labor effected more. It was moral as well as mental force. It was the industry which spared no effect and lost no time. It was the perseverance which no difficulty or disappointment could overcome, the patience that bowed down an emulous and noble spirit to sixty years of toil and ridicule for the victory of an hour, — and the energy, above all, which made time, and sought out knowledge, and created funds and friends, and we had almost said, genius itself. The history of such a character is more than a subject of curious inquiry. It should furnish a lesson for all men and for all times.

Robert Fulton was born in the town of Little Britain, in the County of Lancaster and State of Pennsylvania, some time in the year 1765. It is to be regretted that of many circumstances of his early life, much more important than the precise date of his birth, we have not only no information but no means of obtaining any. He entertained an idea in subsequent years, of writing his own biography, and including memorials of his inventions in all their stages; but this desirable object was never effected, and what is worse, a large collection of his manuscripts put on board an American vessel in 1804, when Mr Fulton left Paris for this country, was lost with the vessel itself, at sea. Little more is known of his parents than that both of them were of Irish extraction. The

mother belonging to an emigrant family and the father being born in Kilkenny. Robert was the third child and the oldest son. His education, so far as his parents furnished it, was such only as he could get at a common elementary school in his native place, where he seems to have resided until his seventeenth year. From this time to his twentyfirst, we find him at Philadelphia, supporting himself by painting portraits and landscapes, though it is no easy matter to imagine where or how he acquired his skill or his science. During this period he made the acquaintance of Franklin and was much noticed by him. He next established himself in Washington County, where with the funds raised from his painting, it seemed he was already able to purchase a little farm on which he settled his widowed mother. Having effected this purpose to his satisfaction, he left her again with the intention of revisiting Philadelphia: but tarrying at the Pennsylvania warm springs in his way, he met with several gentlemen who were so much pleased with the genius he discovered in his paintings, that they advised him to go to England; they were confident he would be cordially patronised by his countryman, Mr West. The young artist yielded to their persuasions, left his native country soon after, and arrived in England during the same year.

His reception by Mr West, who then enjoyed a high and daily increasing reputation in the British metropolis, was more than equal to his warmest anticipations. He was taken into the family of his patron and remained with him several years, constantly receiving the benefits of his instruction and example in the art which was the common favorite of both. After leaving Mr West, he resided two years in Devonshire, probably with a view to painting in that beautiful section of England, to greater advantage than was possible for him in London. Among the valuable acquaintances which he formed at this period, was Lord Stanhope, a nobleman celebrated for his love of science and especially for his attachment to the mechanic arts. Another was the Duke of Bridgewater, famous for his having originated the great canal which has since borne his name, and which at the time of its completion was almost the only work of the same nature, worthy of notice, throughout the British dominions.

It is not unlikely that this intercourse which he enjoyed, both personally and by correspondence with these distinguished individuals had an essential influence over the ardent and curious mind of the young artist. They inspired him with new views of the dignity and value of the mechanics arts, interested him in the great populur projects of the day, and encouraged him to change the character of his own pursuits — the elegant for the more practical. As early as 1793, at all events, we find Mr Fulton engaged in an attempt to improve inland navigation, the particulars of his success in which will be given hereafter. At this period, owing to the loss of the manuscripts just mentioned, we cease to have any other means of tracing his course, then such as are here and there scantily furnished by his transient connexion with the public at large or with some public institutions. It is known, however, that he resided eighteen months at Birmingham, and here undoubtedly, among that collection of hard laboring manufacturers who are described by an English writer as having 'green hair and red eyes,' (in allusion of the confined employments and the deleterious atmosphere which most of them breathe,) he acquired much of that practical acquaintance in the machinery and mechanic principles which was subsequently of such indispensable service to him in his own investigations and experiments. Nor was he wholly devoted to these pursuits, to the neglect of science and study. Under the newly assumed title of civil engineer, he published his well known work on canals, a subject which always occupied a great share of his attention: and he afterwards continued to write upon the same topic for one or more of the best London journals. He confesses in his introduction to the work first named that his thoughts were first turned to the subject of inland navigation by reading some of the papers of the Earl of Stanhope. His book met with the favorable reception from the scientific public which it merited. The particular object of it was to recommend a mode of conveying canals over mountainous countries, independently of locks, rail-ways and steam-engines; this he proposed to accomplish by the use of inclined planes, upon which vessels, construct-

ed properly, with their cargoes, should be raised and lowered from one level to another, or by lifting or lowering the boat and her freight perpendicularly by machinery of very ingenious construction placed on the higher level. This was to be moved by the force of the water, taken from a neighboring eminence and conducted to a water-wheel; or by the weight of a body of water received into a coffer, which was to move in a direct line between the higher and lower level, through a perpendicular shaft or well, sunk in the soil for that purpose. Previous to publication, the design of this work, with models of his machines, were submitted to the British Board of Agriculture, of which Sir John Sinclair was then President, and it was strongly recommended by a resolution of that respectable body. He obtained a patent for his various canal improvements from the British government, as he afterwards did from the government of France.

The residue of the mere life of Mr Fulton — omitting for the present any detailed notice of his labors — might be soon told; for scarcely an individual can be named, we presume, and especially one living at the same period, who has done so much for his fellow men and yet left so little of his private history for their gratification. In 1797, he left England for France, and established himself in Paris, at a hotel where the celebrated American poet Mr Joel Barlow and his family had their residence. That gentleman like Mr West was so much pleased with the manners and genius of Fulton that he induced him to remain in his own house (after leaving the hotel) during the whole of his stay in the city, which was about seven years. We pass over the great variety of daily pursuits and occasional projects which now engaged his energetic and restless mind, only observing that the subject of steam and sub-marine navigation both occupied a considerable share of his attentions. We will present, however, a brief account of the first experiments made with his celebrated plunging boats. They excited great interest at the time, but they are not now so generally understood, especially among the countrymen of the inventor.

In the spring of 1801, he repaired to the seaport of

Brest purposely to try the boat he had constructed during the winter preceding. He knew it to be imperfect even according to his own plan, as first attempts usually are. It had also suffered, from rust, in consequence of his being obliged to use iron instead of brass or copper, for his bolts and arbors. Determined, however, to surmount all obstacles, he boldly launched out upon the harbor of Brest with three companions, on the third of July, and descended in his boat to the depth of five, ten, fifteen, and then twentyfive feet, prudently declining to venture farther down, on account of the unfitness of his frail machinery to sustain the pressure of a greater depth. He remained below the surface an hour, during which time the four adventurers were in utter darkness. He afterwards descended with candles, but finding that these consumed too much of the air essential to his own vitals, he caused a small window of thick glass to be made in the bow of his boat, previously to his second experiment. On this occasion he found that the window though only an inch and a half in diameter, gave him light enough to count the minutes on his watch. Having succeeded thus far, or at least ascertained that he might succeed under proper circumstances, he resolved to try the movements of his boat on the surface; accordingly, on the twentysixth of July, he weighed anchor and hoisted his sails. The breeze being light, she moved only at the rate of two miles an hour; but it was found that she would tack and steer, and sail on a wind or before it, as well as any common sailing boat. The men struck her sails and mast, and prepared her for plunging, all which required about two minutes' time; he stationed a man at the helm, and two others at the engine intended to give her progressive motion, while he with a barometer before him under water, governed the machine which balanced her between the upper and lower waters. He found that with one hand he could keep the boat at any depth he pleased. The propelling engine was then put in motion, and in the space of seven minutes he advanced nearly five hundred yards. He then rose, and upon plunging again, turned the boat round while under the water, and returned to the place which he began to move from.

Between the date last named and the seventh of August, he repeated these experiments so often as to become entirely familiar with the use of his machinery. On the latter day, he descended again, taking with him a copper globe of a cubic foot capacity, filled with atmospheric air, two hundred atmospheres being compressed into it. After remaining under water more than an hour and a half, he began to draw small supplies of *pure* air from his reservoir, and continuing to do so as he found occasion, he passed more than four hours in this situation without suffering the slightest inconvenience.

Mr Fulton gave the name of *the nautilus* to this singular boat. It had one mast, a mainsail and a jib. He found her as obedient to the helm under water as any boat could be on the surface; and the magnetic needle traversed as well in the one situation as the other. He undertook to construct a large boat upon the same plan, capacious enough to contain eight men with provisions for twenty days, and with strength to endure the pressure at the depth of one hundred feet. He contrived also a reservoir of air sufficient for the consumption of the eight men for eight hours. But his funds did not enable him to complete this undertaking, and the half finished vessel was abandoned.

He returned from France to England in 1804, after remaining in the latter country two years, engaged in his favorite pursuits, and more particularly in unsuccessful negotiations with Mr Pitt, Lord Melville, Lord Grenville and others who came successively into power for the sale of certain inventions, he left the country in October, 1806, and arrived at New York in December of the same season. From this time forward he devoted himself, more laboriously and more enthusiastically than ever before to the prosecution of the various improvements and inventions which had long occupied his attention. One of these was the torpedo upon which he had tried experiments in both France and England, in connexion with his sub-marine boat; and which he confidently believed might be made the most powerful instrument of warfare ever used. This and others will be noticed in their place. A still more important subject of

his attention was the application of steam to navigation; for it should be observed that he made no pretensions to the invention of the steam-engine itself. That it might be used, however, as it never had been used, to the immense benefit of commerce and inter-communication among nations and all part of the same nation, he fully believed, and was as fully resolved to spare no effort for the accomplishment of that grand object by his own labors. He had even ordered engines of English manufacture to be sent out to this country some months or years before embarking himself, and he lost no time after his arrival, in making use of them. In this experiment he was aided essentially by Mr Livingston, with whom he had become intimately acquainted in France, (Mr L. being the United States minister to that country), and who had himself done much more towards the very object in which Fulton was engaged than any other individual of the age. As he did not by any means succeed, however, it was creditable to his magnanimity that, upon examining the models and witnessing the experiments of Fulton, he was ready not only to admit his success, but to promote it still farther by furnishing funds and by his personal assistance. In the year 1803, an operating steam-boat was at last built upon the river Seine, under the direction of Fulton. This worked as well as could be expected, and quite well enough to induce both to unite in building a second and considerable larger vessel in New York.

This vessel, the first of the kind ever constructed in America, was launched on the East River near New York in the spring of 1807, just in time to fulfil the conditions of a legislative act, by which the privilege of exclusively navigating all the state waters by fire or steam had been granted to Livingston and Fulton for the term of twenty years. On the memorable occasion first named, these gentlemen themselves, intensely interested in the event of the first trial, had invited many of their friends to witness it with them. 'Nothing,' it has been said by an eloquent writer, 'could exceed the surprise and admiration of all who observed the experiment. The minds of the most incredulous were changed in a few

minutes. Before the boat had made the progress of a quarter of a mile, the greatest unbeliever must have been converted. The man who, while he looked upon the expensive machine had thanked his stars that he had more wisdom than to waste his money on such idle schemes, changed the expression of his features as the boat moved from the wharf and gained her speed: his complacent smile gradually stiffened into an expression of wonder. The jeers of the ignorant, who had neither sense nor feeling enough to suppress the contemptuous ridicule and rude jokes, were silenced for a moment, by a vulgar astonishment which deprived them of the power of utterance, till the triumph of genius extorted from the incredulous multitude which crowded the shores, shouts and acclamations of congratulations and applause.'

This boat, which was called the Clermont, soon after sailed from a dock near the State prison, for Albany. She arrived at her destination without any accident, everywhere exciting the astonishment of the inhabitants of the banks of the Hudson. Many of them had never heard of a steam-engine, much less of a steam-boat. Some of the ignorant and superstitious are said even to have been alarmed by her first appearance, as she came up against wind and tide, breathing out flame and smoke, and dashing the waters under her wheels with a noise of thunder. The darkness of the night it may easily be conceived, did not tend to lessen the fears of these people. The minutiæ of this memorable voyage have been recorded by the triumphant architect himself, who was on board. The boat reached Clermont, (the seat of Livingston) in twentyfour hours, the distance being one hundred and ten miles, and the remaining forty were passed over in eight hours, being an amount of one hundred and fifty miles in thirtytwo hours, or very nearly five miles an hour. The return passage was performed in precisely thirty hours. It may be added in this connexion, that the Clermont, after this successful experiment, was advertised and established as a regular passage boat between New York and Albany. She met with several accidents during the season, owing to the various

imperfections in the machinery which were gradually remedied. Her water-wheel shafts, for instance, were of cast iron, and were insufficient to sustain the great power applied to them. They were also hung without any support for the outer end of the shaft, which has since been supplied by what have been called the wheel guards. The misfortunes which the boat met with gave some occasion for the revival of incredulity and ridicule among many who were ignorant of the principles upon which she was navigated, and still more who were interested to prevent her success; but she nevertheless continued to run as a packet during the remainder of the season, and was constantly loaded with passengers. She was enlarged the next winter, and in the spring of 1808, again commenced running with greater success than before.

In February, 1809, Mr Fulton took out his first patent for his inventions in navigating by steam. From that period the progress which had been made in this great department of commerce is familiar to most of our readers.* It may not be as generally known, however, either how great were the difficulties and discouragements attending the first experiment — independently of the intellectual and physical labor — or how little profit ever accrued to the inventor himself, from the magnificent achievement which has so long been giving subsistence, and wealth to thousands of his countrymen. The act of the New York legislature, just alluded to, was first obtained in the year 1798, in favor of Mr Livingston, who was at that time most zealously engaged in his unsuccessful attempts. The bill for allowing him a monopoly of the steam navigation within the state, was introduced by the learned Dr Mitchell of New York, he being then a representative from that city. 'Upon this occasion,' Dr M,

* From 1811, when the first western steam boat was launched, to the Spring of 1831,there has been employed on those waters four hundred and two steam boats, of which two hundred and twenty were in use last year, and one hundred and eightytwo not in existence. Of these sixtysix were worn out, thirty-seven snagged, sixteen burnt, three run down by other boats, four or five stove by ice, sandbars, rocks &c, and thirty destroyed by causes not exactly known. No less than sixty boats have been building or contracted for within the present year. (Philadelphia Chronicle.)

afterwards said, the 'wags and the lawyers in the house were generally opposed to my bill. I had to encounter all their jokes and the whole of their logic. *One main ground of their objection was, that it was an idle and whimsical project, unworthy of legislative attention.'* Another gentleman, then a member of the senate, has stated that the application of Mr Livingston was a standing subject of ridicule throughout the session, and that whenever there was a disposition in any of the younger members to indulge a little levity, they were in the habit of calling up the steam boat bill, and diverting themselves at the expense of the project. The builders of the Clermont were continually exposed to public ridicule; and so difficult was it for Mr Fulton to raise the funds necessary for the completion of this vessel, that he made an offer of one third of the monopoly we have spoken of to any gentleman who would pay a proportionate share of the expenses; not an individual, even among his personal and warm friends, could be found willing to embark in the enterprise.

Nor was indifference or ignorance by any means the only obstacle which he met with in his struggle with public opinion. It may be conceived how far the spirit of actual hostility had carried itself, when we observe that the New York legislature thought it necessary, by an act of 1808, to declare combinations to destroy the new boat, or wilful attempts to injure her, public offences punishable by fine and imprisonment. Even this being proved insufficient, an additional act was passed, three years afterwards, giving certain summary remedies against those who should contravene the protecting laws. These provisions served in a great measure to suppress the meanest efforts of private malice. But Mr Fulton was obliged to contend also with open and authorized enemies. It will be readily imagined, that such, under the circumstances of his great invention, must almost necessarily be the case, its direct tendency being, so far as it succeeded, to reduce essentially the employment and profits of other departments of navigation, if not entirely to suspend their operations. Hence the packet masters, and especially those who sailed to and from the city,

were violently opposed to the new project. The act of 1811 even expressly excepted two boats which were then navigating the Hudson, and one which was running on lake Champlain, not because they intended to countenance any interference with Fulton's monopoly, we presume, but because these boats were already running when the new and severe provisions were passed, and the legislature thought it the true course to leave the patentee to his previous remedy.

The contrivance adopted by the owners of the two opposition boats upon the Hudson for evading the act, is a fair specimen of the vexatious manners with which Fulton was obliged to contend. It seems these vessels were at first to have been propelled by a sort of pendulum, which certain shrewd calculators supposed capable of giving a greater power than the steam they intended to rival. Unfortunately when their first boat came to be put in the water, they found that the wheels, which were turned with great ease while the vessel stood high and dry upon the stocks, could not be made to perform their functions in the water, without the application of a great force to the pendulum. The projectors were now embarrassed for some time. They perceived the necessity of using steam, and yet knew of no other way of applying it than the one already adopted by Fulton. They finally concluded to avail themselves of all the machinery used in his boats, excepting some very slight parts left out, and perhaps some equally insignificant parts put in for the express purpose merely of giving the pendulum-makers a pretence for claiming to be the inventors of improvements in the steam-boat, and so getting a patent accordingly. Livingston and Fulton appealed to the protection of the law which had been made in their favor. The Judge of the Circuit Court of the Union, who was applied to for an injunction upon the new boats, decided that he had no jurisdiction of the case. The New York Court of Chancery, after hearing an argument for several days, came to the same conclusion. From this decision there was an appeal, and in the winter of 1812, the Court of Errors (composed, in cases of appeal, of the Senate of the State, and the Supreme Judges) unanimously

reversed the decision of the Chancellor, and ordered a perpetual injunction, so that the new boats, as a writer on this subject has observed, 'could thereafter no more be moved with steam than they could by a pendulum.'

It was thus that, during the whole time Mr Fulton devoted himself to the service of his country and the world, he was perpetually harassed by lawsuits and controversies with those who were violating his patent rights. The most remarkable of these contests was occasioned by a strenuous effort made by certain persons interested in running boats between New Jersey and New York, to induce the New York legislature to revoke the monopoly they had granted to Fulton. They succeeded so far that the committee to whom the first examination of the subject was referred, reported in favor of the new claimants; but the legislature decided otherwise, though not until the senate and assembly in joint session had received the testimony and heard the arguments offered by Mr Fulton and his counsel, the celebrated Mr Emmet. The positions upon which their opponents founded the new claim are worthy of notice. One was, that the petitioners had purchased the patent of one John Fitch, who, it should be observed, had received it in 1786, from the legislatures of New York and New Jersey, for the term of fourteen years, and this term had elapsed in the year 1800, without Fitch's ever having attempted to establish a steamboat anywhere, or of any kind. It afterwards appeared that this right had been bought up for ten dollars of a person pretending to be a remote relation of Fitch. In the second place a claim was advanced in behalf of one David Dodd, who was said to have invented what he called a *parallel link*, for uniting certain parts of the steam machinery in a manner not practised by Mr Fulton. Our limits compel us to omit a particular description of the numerous minor works in which Mr Fulton was engaged, subsequent to his arrival in this country, each of which alone might have been enough to do immortal honor to his genius. As we approach the last scenes of his life, it is saddening to observe how the vexations of mean rivalry and jealous opposition which had embittered his best days, as far as such things could, still hunted him down

long after his splendid triumph over prejudice and ignorance had been gloriously consummated in the admiration and astonishment of the world. In January, 1815, Mr J. R. Livingston, who owned the steam-boat running between New York and New Jersey at one time, but afterwards stopped by the operation of the Jersey laws, petitioned the legislature of that state for their repeal. Counsel was heard, and testimony admitted upon this occasion, and among the latter was Fulton himself. The weather was uncommonly cold while he was at Trenton upon this business, and he was a good deal exposed to it, in attending the hall of the legislature ; he took cold, and it fell upon his lungs, which had already been affected by the extreme fatigue and exposure he had occasionally undergone for several years previous. Instead of confining himself to his chamber, however, the moment his testimony was received, and Livingston's object effected, he set out upon his return for the city. The Hudson, which he and his friends (among whom were Livingston and Emmet) were obliged to cross, was partly closed with ice ; so that he was detained some time in waiting for a boat to convey them from Paulus Hook to that part of the river which was frozen. This interval, of not less than three hours of very inclement weather, — it is a circumstance vividly characteristic of the man — he passed in visiting his works upon the river side, and examining the boats which were then repairing for the next season. Again, in crossing the ice, Mr Emmet fell through, and was in a situation attended with some danger. Fulton was greatly agitated, and exerted and exposed himself for his friend in a manner which left him exceedingly exhausted. In continuing their walk across the ice, owing to the great quantity of water lying upon it, he became very wet. On arriving at his house he could scarcely speak from hoarseness. He was confined for two or three days, when being somewhat relieved of his cold, he ventured out imprudently *to visit the steam frigate*, on the New Jersey side, which was now the great object of his solicitude. In giving his usual superintendence to the workmen, he exposed himself again to bad weather. His indisposition returned upon him, confined him to his

house and bed, prevailed over his whole system, and finally terminated his life on the 24th day of February, 1815.

The honors paid to the memory of Fulton are but one more instance of the slow but sure recompense which genius, guided by an enlightened patriotism and supported by an indefatigable perseverance, always must attain. The newspapers of New York which announced his death, wore such marks of mourning as are usual in noticing the decease of public characters. The municipal corporation, and the various literary institutions and other societies, assembled and passed resolutions expressing their admiration of his character, and their regret at his loss. And not only did these bodies determine to attend his funeral and to wear individually badges of mourning, but the order last mentioned was taken by the legislature of the State, an honor, it has been observed, never before paid in this country on the death of a private citizen, distinguished through life only by his talents, his virtue, and his magnificent achievements. Independently of the corporations and societies just mentioned, his funeral was attended by a greater number of citizens than had ever before collected in the city on any similar occasion. The coffin which incloses the remains of Fulton — indicated only by a simple engraving of his name and age upon a metal plate — lies in a vault belonging to the Livingston family, with which, since 1806, he had been connected by marriage.

It is by no means intended to intimate, by the observations just made upon the posthumous reputation of Fulton, that he was either unknown or unhonored during his lifetime. On the contrary, he was not only beloved in the private circle for his eminent private virtues ; for the mildness, the sincerity, the cordiality, and the generous instincts of every kind, which independently of his fine powers of conversation and his animated manner, rendered his society always a pleasure ; but he received testimonies of public regard, both in this and in other countries, with which he had abundant reason to be satisfied. Some of these have been alluded to. It may be added, that very soon after his arrival at New York from Eng-

land, he was elected a director of the American Academy of Fine Arts; a member of the New York Historical, and of the United States Military and Philosophical Societies; and upon the organization of the Literary and Philosophical Society of New York, he was chosen one of its original fellows.

These distinctions are not enumerated to prove that Mr Fulton was courted as a personage of a brilliant reputation, already established as it now is. He was looked upon more as a man who deserved a high reputation, than as one who had already enjoyed it. At this very period, in fact, the grand invention which has since been, as it will be forever, the foundation of his imperishable fame, was yet only a worthless complication of ingenious gimcracks in the minds of many; perhaps a by-word of ridicule and reproach with numbers even of respectable people; and at best an experiment concerning which most of those who wished him well felt far more anxiety than hope. 'The morning,' he says himself, in a letter written to his friend Barlow, immediately after the first voyage to Albany, 'when I left New York, there were not perhaps thirty persons in the city (he might have said five) who believed that the boat would ever move one mile an hour; and while we were putting off from the wharf, I heard a number of sarcastic remarks.'

Fulton was a scholar, a man of extensive and luminous science, and of frequent and intense study. No great inventor, in fact, was ever less indebted to what is called good fortune. Everything which he effected was ultimately effected by the same severe, patient, unintermitted application which has always been, and always will be indispensable to all success of the same nature. A man may be remembered, as having fortunately stumbled upon some important *discovery*, as the Indian developed the rich ores of Potosi; but an *invention* never was stumbled upon. It cannot be from its nature; and least of all an invention, which consists of an intricate combination of machinery, preadapted to a required operation and intended necessarily to be wrought upon by the elements, and to work with them. It was precisely thus that Fulton, from the moment when his ardent

mind first reasoned itself into an estimate of the great service which a system of steam navigation might render to the world, set himself at work first to solve the problem, in abstract principle, and then to embody his demonstration in wood and water. For a long time he preserved the various models, drawings, and calculations, which from year to year exhibited the result of his studies; but many of these precious memorials were lost to the world at the same time with the other valuable papers already referred to. It is said by those who knew him best, that he never attempted to put in practice any improvement in mechanics, without having first drawn his plans and executed his models. No doubt there is equal truth in the suggestion, that many of the contrivances for which claims have been since made as for new inventions (because they differed from those which he finally adopted in practice) occurred to him, and were rejected after consideration and experiment.

Some sketch of the various pretensions and attempts which have been made, at different periods, in different countries, to invent or, at least to gain credit for inventing, a successful method of applying steam to navigation, will show that this method was emphatically what we have termed it — a problem — the interest of which and the benefits to be expected from its development, were long and generally understood. It has been asserted that an Englishman conceived some idea of a steam-boat more than ninety years ago, the evidence of which consists entirely in an old pamphlet published in London by one Jonathan Hull, as a 'Description and draught of a new invented machine for carrying Vessels or Ships out of or into any Harbor, Port or River, against wind or tide, or in a calm.' This treatise, however, is said to contain no allusion to any other than the earliest atmospheric steam engines, which the author supposes, *if applied to a vessel*, 'must drive it with great force.' It was not until about thirty years after this, that the steam engine — unconnected with navigation at all, — was brought to anything like its present perfection, in consequence of the invention of the separate condenser by Mr Watt, though the Marquis of Worcester had discovered the expansive

power of steam as early as 1663, and Captain Savary had taken out a patent for an engine to pump the Cornwall mines, in 1666. Mr Newcomen added the piston to the cylinder in 1705. Setting all these aside, as having done nothing in fact towards the application of steam to the propelling of vessels, we find an English claim rather faintly advanced in favor of Messrs Hunter and Dickinson, who took out a patent in 1801, and who are said to have succeeded in propelling a vessel on the river Thames at the rate of three miles an hour. But it does not appear that this experiment gave any such encouragement as to justify its continuance, although it does appear that the inventors had the advantage of knowing what had been done by Lord Stanhope and several other authors of abortive attempts. It is tolerably well ascertained that the nobleman last named, whose pretensions certainly deserve most consideration, expressly submitted to the right and claim of Mr Fulton. The correspondence which passed between them, still preserved, is a clear testimony to this effect. A claim had been set up in France also, in favor of the Abbe Arnal, dating as far back as 1781; but it seems sufficient to number this experiment, if such a one ever was made, with the numerous class of mere attempts never heard of beyond the year of their birth. The Scotch, too, pretend that in the same year a steam-boat was constructed on the Forth and Clyde canal, which drew two or three vessels, of sixty or seventy tons each, at the rate of over two miles an hour; but this statement requires to be further authenticated, and at the best bears but a poor comparison with the performances of the first boats of Fulton. One of the latter, the Paragon, of three hundred and thirtyone tons burthen, towed the steam-frigate Fulton, of the burthen of two thousand four hundred and seventyfive tons, from her ship yard in the Sound to the city of Jersey on the Hudson, at the rate of four miles an hour. But whatever the Scotch experiment might be, it is well ascertained that Mr Fulton knew nothing of it. What is more to the purpose, nothing indeed was known by the most learned and scientific individuals or societies in this country, of any successful attempts, as late as 1803. During that season, applica-

tion was made to the Am.Philosophical Society by an institution in Rotterdam, to be informed what had been effected by the Americans in steam navigation. The answer, drawn up by a gentleman of distinguished science, is very full, and very elaborate, and though] it specifies numerous abortive experiments made at various periods in this country, it not only records them all as abortive, but reasons at length upon the absolute improbability that any experiments of this nature ever should succeed. The objections are worth noting. They are, first, the weight of the engine and the fuel; second, the large space it occupies; third, the tendency of its action to rack the vessel and render it leaky; fourth, the expense of maintenance; fifth, the irregularity of its motion and the motion of the water in the boiler; and sixth, the liability of the paddles to break on the one hand, and the danger of their being too heavy on the other. The writer adds, that although respectable and ingenious men then believed in the practicability of steam navigation, he had never been informed of a tolerably successful experiment, upon any other testimony than that of the inventor. It is an interesting fact, that the celebrated Franklin was among the multitude of those who had engaged in the study of this subject. An essay of his, read before the Am. Philosophical Society is still preserved, in which he undertakes to prove that the idea of propelling vessels by water-wheels, since thought to be essential to steam-boats, was chimerical; and he gives a drawing and a demonstration in aid of his argument to this effect. His own plan, it seems, was to propel a boat by forcing a column of water, through a channel made for that purpose in the keel, out at the stern.

Two or three of the other theories and trials, made about this time, are worthy of some notice, at least as singular illustrations of the fact we have mentioned, that the application of steam to navigation was generally understood to be an important object, and that the desire to effect it was productive of proportionate efforts. Mr Fitch, an ingenious mechanic of Philadelphia, constructed a boat, in 1783, which was to be propelled by paddles instead of wheels. This vessel was actually moved up

and down the river Delaware; and as the inventor was assisted by an association of scientific gentlemen, who advanced large sums of money for the perfect completion of the machinery, it would seem that he had every opportunity which the nature of his calculations allowed, for making his experiment successful. It failed nevertheless. The vessel and the project were laid aside together; and this even after Mr Fitch and his associates had obtained an exclusive right to navigate not only the waters of Pennsylvania, but of New York also, and of several other States in the Union.

Virginia was among the States which refused, for some time at least, to grant such a monopoly; and this circumstance brings to view the claim of another projector, Mr James Ramsey. This ingenious American artist published a pamphlet in 1788, to prove, upon the testimony of Gen. Washington and others, that his 'right to the steam invention' was prior to that of Mr Fitch. It is satisfactorily shown in his essay, upon the whole, that Mr Rumsey made a sort of steam-boat in 1784. He soon afterwards disclosed his plan to Washington, and it was in consequence of information to this effect indirectly furnished by the latter, that the Virginia Legislature refused, as we have seen, to grant Fitch the monopoly for which he petitioned. Ramsey is said to have built a second boat in 1785. The year ensuing, he made an unsuccessful trial with her. In December, 1787, having improved her machinery in several particulars, he tried her again upon the Potomac, when she moved at the rate of over three miles an hour, having on board two or three tons weight besides her machinery. This, however, weighed only about eight hundred pounds. Her boiler would now be considered a curiosity; it held only five gallons, and needed only a pint of water at one time. The whole machinery, according to Mr Ramsey's well authenticated statement, occupied no more space than the bulk of four barrels of flour. The boat is supposed to have been about fifty feet in length. The consumption of coal amounted to six bushels in twelve hours.

This vessel was propelled, as Franklin afterwards pro-

posed to propel one, by forcing water, by means of the engine, through a trunk in the bottom of the boat. The boiler is described as consisting of iron pipes bent so as to cross each other at right angles, forming cavities like a bottle-case, in which the fuel was burnt. The chief objection to this construction seems to have been, that a considerable part of the heat escaped.

Mr Ramsey, some years after his first attempt, built a boat in London which was tried upon the Thames; but it does not appear that he succeeded in either case even to his own satisfaction. It was one of his ideas, that the force of steam might be advantageously applied to long poles, which should reach the bottom of a river, and by that means push a boat against a rapid current. Whether this was a part of his actual arrangements in the case of his experiment on the Potomac, we are not informed. From the following passage of a letter from one of his patrons, the distinguished Benjamin Rush of Philadelphia, to Dr Lettsom of London, it may be fairly conjectured, perhaps, that Mr Ramsey relied upon his poles 'to increase the velocity of his boat' for the future, without having yet given them the trial. 'Mr R.' writes the learned doctor, 'possesses a very uncommon mechanical genius. He has invented a boat which sails, by means of steam, four miles an hour against the stream; he expects to increase the velocity of his boat to ten miles an hour, *by the application of the principles of his new steam-engine to the discovery*.' Of this last named improvement nothing is known; but the document we have just cited will undoubtedly be regarded as good evidence that the inventor succeeded to a certain extent, while others show, and especially other *facts*, that he failed essentially in his grand object.

The imperfect sketch we have thus given of a few of the abortive attempts made to apply steam profitably and permanently to the service of navigation, though strictly a digression from our main subject, will not be considered, we trust, wholly without interest or value. It may illustrate the sense which ingenious and scientific men, for nearly two centuries past, have had of the grand but undeveloped principle which it remained, after all, for

Fulton thoroughly to demonstrate, first of course in theory, and afterwards in practice. No doubt, well acquainted as he always made himself with whatever useful information was within his reach, upon any subject in which he engaged his attention, he was well aware of what had been done by his disappointed predecessors. No doubt that he borrowed many suggestions from their failures. They seemed to confirm and to facilitate the results of his own private investigations: and there is great reason to believe, as we have intimated before, that most of the failures of other inventors were in a certain sense failures of his own. That is, he commenced his researches and reflections, as some others did, with the first principles of philosophy and mechanics. From these too, he advanced slowly, as they did, in his closet speculations at least, until he effected some real discoveries, and at the same time unquestionably fell into some temporary errors. But here the parallel closes. The predecessors of Fulton wanted qualifications for pursuing the paths they had struck upon before him, which he only possessed. Independently of his natural abilities — which we choose to leave out of the question at present — and independently of the superior opportunities of discipline, of essential assistance from friends and of more information, which he enjoyed in Europe for many years, and which he certainly deserves the credit both of procuring and of profiting by, there was a union of requisites in the character of Fulton, moral as well as intellectual, all which were indispensable to his success, but some one or more of which was wanting to each of his competitors. One of this number, who was a professed mechanic, perhaps, and probably well versed in mechanic principles, was destitute of the mental discipline essential to the patient pursuit and the luminous development of systematic and scientific investigations, which in the closet so much facilitated the labors of Fulton upon the ocean. Another, who had science and education, and general information enough, was ignorant of machinery, or incapable at least of accompanying and illustrating the results of his own mind by the works of his own hand. Others *might* have advanced farther than they did — as the navigators prior to Columbus might have

discovered America — but they wanted the patience of severe intellectual labor; the perseverance through all but endless labyrinths of winding speculation and fruitless repetitions of expensive experiments without system and without success; the industry — the energy — the self-possession necessary to new exertions under discouragements, and not less necessary to restraint and composure in cases of temporary and trifling success. They gave up to indolence. They suffered themselves to be diverted from their ultimate purpose of pursuit by *golden apples*. They were discouraged by delay; and nettled by vexatious disappointments; and stung by the ridicule of the ignorant, and the indifference of better men. They wanted the unconquerable will to do and to endure everything and anything, for any length of time, which has laid and must lay at the foundation of all the illustrious triumphs of the human intellect.

The *perseverance* of Mr Fulton was too prominent a trait in his character to be passed over, without specially commending it to the observation and imitation of all who promise themselves reputation or success, in any department either of science or labor. His sub-marine boat was a very favorite project with him; but many were the fruitless efforts he made to procure funds enough for trying the suitable experiments with it, even after he had completed the machinery itself. He applied first to the French Directory. They encouraged him to hope for assistance, but after a long and irksome attendance at the public offices, to his great surprise he received a note from the minister of war, informing him that his plan was totally rejected. Still undiscouraged, he executed a handsome model of his machine; and a change having taken place as to one of the officers of the Directory, he again submitted his project. A commission was appointed to examine it. They reported favorably, but after another three months' attendance, the author was again given to understand that nothing could be done for him.

He now made application to the Dutch government, and failed: and a second time with the same result. He began a negotiation with individuals of that nation: but by this time, Bonaparte was First Consul of France. Ful-

ton returned to that country, and presented an address to him. This was to a certain extent successful: and here at length opened the first prospect which had yet greeted him, of so much as an opportunity to ascertain what *might* be effected at some future time. Many more discouragements awaited him, but he triumphed over all.

In regard to the very tedious and difficult experiments made upon the torpedoes in this country, a biographer of Mr Fulton observes with great justice—'no opposition or contradiction, no failure or disappointment, irritated, discouraged, or discomposed him. When his machines were broken or disordered, he, with the utmost calmness and composure, pointed out their defects or the causes of his disappointment. If an experiment failed, though it had cost him great pains and labor in the preparation, and though the failure was frequently and obviously owing to the awkwardness or unskilfulness of those who assisted him, his temper could not be disturbed. He would not hear the scoff of several of the numerous bystanders, which were often expressed in whispers intended to reach his ear. Not a fretful word ever escaped him. Even when his physical strength must have been exhausted by his corporeal exertions, and excessive fatigue, his spirits were never for a moment depressed.'

[To be continued.]

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LIFE AND CHARACTER OF ROBERT FULTON.

[Concluded.]

In our comments upon the character of Fulton as connected with his success, we have hitherto laid no stress upon what many would consider his *genius*. There is always an objection to the use of this term from its vagueness. It is intended to signify an indefinite and perhaps indefinable idea; for it has never come to our own knowledge, at least, what is the precise distinction between *talent* and *genius* — and we may add another vague word, *sense*. It is well known, however, that all these qualities or combination of qualities, have been discovered, or at least supposed to have been, in various degrees, where they were far from being looked for. The benefactors and the ornaments of their race have not only sprung up in all nations and climes, but from all grades of society; and their fame has generally been only the more brilliant, as it will be the more lasting, from the contrast between the lustre of their final success and the obscurity of their origin. Who would have ventured to predict of the young Whitefield, when he waited upon the customers of the 'Gloucester Inn,' that the time would soon come when his mere personal influence over his fellow-men should exceed that of any other individual, perhaps, of modern times? Who would have predicted of Franklin, in his thirtieth year, that his fame would one day be extended

beyond that of all his cotemporaries, for discoveries, even in abstract science, which had baffled the inquiry of ages. It is certainly difficult, in the innumerable cases of this kind which might be adduced, to perceive any foundation for the distinctions alluded to. The characteristic of Franklin is very generally said to have been his *common sense*, and yet what more than this was the *genius* attributed to Davy, or how much more could it have done for him. The best criterion of human intellect, after all, as of moral character, is in its fruits. Whether all minds are originally equal, is neither possible nor necessary for us to decide. It is enough, that all have been proved to be capable of a progress which may be called infinite; and that no individual can know, at all events, without a complete experiment with himself, but that *he* is the *fortunate* one, if there be any such, *born* to be immortalized by the triumphs of art, and the victories of science.

One meaning, however, has been attached to the word *genius* that will bear examination — and that is, to denote a mental aptitude for certain employments, which is of course owing to a certain combination of qualities. And for this distinction — which, by the way, evidently makes it quite as irrelevant to compare one mind with another, as it would be to compare two particular traits — there appears to be a foundation in actual experience, as there is certainly in reason and analogy. Hence it is a common saying, even with ignorant observers, that particular persons are or are not educated or situated as they should be. Hence, an apparently intelligent and ambitious individual will often change from one occupation to another, and be ill at ease and unadjusted in all. In other cases accident developes mental peculiarity, and probably confirms it. Such has been the history in fact, as might be supposed, of most of those who have succeeded best and soonest in pursuits of every description. Garrick and Cooke were the life of theatrical companies at school. Whitefield himself occupied his leisure at the tavern in writing sermons. Bonaparte was a soldier at fifteen, and a general at twenty. Haydn earned his subsistence as a musician almost from his infancy up; and Handel, while a mere child, used to resort privately to an

old clavichord, (an instrument strung with catgut,) and play for hours upon it in a remote apartment, while the rest of the family were asleep. Michael Angelo was only permitted to pursue the profession which he so much honored, from the circumstance that he persisted at school in devoting so much time to it, as to be an incorrigible scholar in every other department of study. All these were men of genius, or rather of *a* genius, and that so distinct and decided — *precocious* is the term in common use — as either to be readily developed by accident, or at least to force itself through the opposition and obscurity of circumstances. It is not at all likely that Cooke could have been made a great tactician or a great musician by any process; and Napolean would as certainly have made a sorry figure upon a stage of any smaller dimensions than a kingdom.

To return from a digression — Fulton is said to have given decided marks at an early age, of a genius for the pursuits of his after life, and in which, after his interval of painting, he finally established himself, never to forget or forsake them. 'In his childhood,' says a biographer, 'all his hours of recreation were passed in the shops of mechanics; and even at this period he had no other desire for money, than to supply himself with the necessary materials to indulge his taste for mechanism, and drawing.' It was thus incidentally, and of his own free suggestion, that he acquired the art of painting so well as to subsist himself by his portraits and landscapes for several years of his boyhood, in the city of Philadelphia. It is worth noticing, of what essential service was even this accomplishment in Mr Fulton's subsequent labors, as his skill in drawing particularly was of still more. There could hardly be a more striking illustration of the importance of uniting skill with science; of being at once the speculator and the mechanic. The plates attached to Fulton's work on canal navigation, were all the work of his own hand. Another specimen of his mechanical genius may be seen in the original splendid edition of his friend Barlow's *Columbiad*, (published at Philadelphia in 1807, and dedicated to Fulton) all the fine plates of which were furnished by himself.

An anecdote is related, that while in Holland, intensely engaged in the prosecution of one of his most brilliant discoveries, which he wished to recommend to the notice of that government, he amused himself at brief intervals with making sketches of the scenery of Holland, and of the figures, costume and manners of the people. These are said to be still preserved, and to afford abundant evidence both of his humor and his skill. We have already observed that his models, like his drawings and diagrams, which were and are very numerous, as well as very perfect, were all of his own workmanship.

His general acquaintance with practical mechanics was still more serviceable, especially in enabling him to give suitable directions to others, for constructing machinery which he was not himself in a situation perhaps even to superintend. The first engine which was ever successfully used in a boat, was made for him, in this manner, by Watt and Bolton — they being in England and he in France, if we mistake not — and yet arranged with such nicety, and reduced so accurately within the proposed compass, that it was found to operate precisely according to his calculations, and that though it passed through the hands of another set of workmen, in still another country, before it could be brought to a trial.

The manner in which he exposed Mr Redheffer, and his famous imposition, in the form of a machine said to be made capable of *perpetual motion*, is an amusing incident, going to show his knowledge of mechanics. It must be known to most of our readers, that Redheffer, in his time, absolutely succeeded in convincing multitudes of people, not only that such a thing could be constructed, but that it had been, and that he himself was the fortunate inventor of this prodigious desideratum. 'Many men of ingenuity, learning and science,' it is said, had examined the machine, and not a few of these became his zealous advocates. Some condescended to write upon the subject. 'Others, though unwilling to admit that he had made a discovery which they said must violate the established laws of nature, were also afraid to deny what the incessant motion of his wheels and weights seemed to prove.' Their only resource, therefore, was in contri-

ving ingenious theories, and explanations quite as singular as the machine itself. It was vaguely maintained, for example, that Redheffer had a way of *gradually developing some hidden power*, which might serve to keep his performance in operation for an indefinite length of time at least, though perhaps not absolutely forever.

The gimcrack which occasioned all this solemn debate and farcical embarrassment among the scientific and the studious, finally became so profitable, that duplicates were made of it, and sent about the country as shows. One of them commenced its career at New York in 1813, and the curiosity respecting it was such in that city that thousands flocked to see it. Not a few of them were respectable men, and many of these were thoroughly persuaded of the propriety of the inventor's pretensions. Mr Fulton was reluctant to visit the machine, but was finally induced to do so by some of his friends. It was kept in an isolated house in the suburbs. In a few minutes after entering the room, where the machine was exhibited, Fulton exclaimed — 'Why this is a crank motion.' His practised ear, it seems, enabled him to distinguish the noise made by the operation of an invisible crank, which, as it always gives an unequal power, gives also an unequal velocity in the course of each revolution. The consequence is, as it was in the present instance, a want of uniformity, though sometimes not perceptible to the ear of an ordinary observer. If the machine had been moved as the inventor pretended it was, there would have been a uniform sound and an equable rotation. Fulton satisfied himself still farther of the imposition, by a short but searching conversation which he held with the showman. He finally told him, without hesitation, that he considered him an impostor. Mr Redheffer was angry of course, or at least affected to be so. But Fulton, probably induced by his manner to go farther than he had first proposed to do, addressed himself to the company; and pledged himself, if they would support him, to detect the cheat or forfeit any penalty in case of his failure.

He obtained the assent of all who were present, and commenced the process of exposure. 'He began,' says

one who appears to have been an eyewitness of the amusing scene, 'by knocking away some very thin little pieces of lath, which appeared to be no part of the machinery, but to go from the frame of it to the wall of the room, merely to keep the corner posts of the machine steady. It was found that a catgut string was led, through one of these laths and the frame of the machine, to the head of the upright shaft of a principal wheel. The catgut was conducted through the wall, and along the rooms of the second story, to a back cock-loft, at the distance of a number of yards from the room which contained the machine; and there was found the moving power. This was a poor old wretch with an immense beard, and all the appearance of having suffered a long imprisonment, who, when they broke in upon him, was unconscious of what had happened below. He was seated on a stool, turning the crank with one hand and holding a crust to his mouth with the other.' The residue of the story is soon told. The proprietor of this perpetual motion disappeared, and the mob demolished his machine. Another was at the same time being exhibited in Philadelphia, the profits of which were of course suspended by the detection and destruction of its fellow.

On the occasion heretofore mentioned, when the first steam-boat of Fulton was launched, amidst the shouts of an immense multitude of admiring spectators — all of them not only satisfied but astonished by the movement of the vessel—she had not been long under way, when Fulton, who was on board watching her progress with intense scrutiny, suddenly ordered the engine to be stopped. He had perceived that a trifling error existed in the construction of the water-wheel. He immediately gave directions for lessening their diameter, so that the buckets took less hold of the water, and the boat was again put in motion with a speed considerably augmented. It is sufficiently obvious, that a perfect familiarity like this with machinery, as well as with the general principles by which it is governed, must be of immense, we may say, perhaps, of indispensable benefit, to all inventions, and especially of intricate combinations. It will be recollected, that among other opportunities of which Mr Fulton

availed himself to acquire this knowledge, was his residence, for a year and a half, among the manufactories of Birmingham.

His whole life, in fact, was a series of mechanical inventions, with only such intervals of study and experiment, as seemed to be essential to the numerous results which he effected. Some notice of these inventions, other than those which have been already the subject of comment, independently of any intrinsic interest, will serve to illustrate the real genius and character of Fulton better than the most labored disquisition. It is by no means probable that we can now enumerate the entire catalogue, or properly appreciate the labor which they must have cost him; but enough will be seen to justify whatever has been said of his industry, his energy, his enthusiasm and his science.

Besides acquiring all the school education which he ever received, we have seen that, previous to his seventeenth year, he had attained to no ordinary degree of skill in the arts of drawing and painting, entirely at his own suggestion. Of several years spent in England, subsequently to his leaving the family of Mr West, few memorials are preserved; and his course is consequently left in a great degree to conjecture. As early as 1793, however, we find him actively engaged in a project to improve inland navigation. Even at this time, he had conceived the idea, and no doubt had formed some particular plan, of propelling vessels by steam. He speaks in some of his manuscripts with great confidence of its practicability; and a letter from the Earl of Stanhope, dated in October of the year last named, and found among the papers of Fulton, proves that he had even then communicated with that nobleman upon his favorite subject. 'I have received,' says the latter, 'yours of the thirtieth of September, in which you propose to inform me of the principles of an invention, *which you say you have discovered, respecting the moving of ships by means of steam,*' &c. But Fulton by no means limited by his active mind to a barren speculation upon one subject; or rather we should say, such was the wide scope of his intellect, and the liberal range of his studies,

that he unavoidably fell into many incidental investigations, which were in fact digressions, foreign to the main purpose of his labors, though by no means without their own use to him.

In May, 1794, he obtained from the British Government a patent for a double-inclined plane. During the same season, he submitted to the British Society for the promotion of Arts and Commerce an improvement on his own mills for sawing marble, for which he received the thanks of the society, and an honorary medal. Soon afterwards, he invented a machine for spinning flax, and another for making ropes (and obtained patents in both cases) as also a mechanical contrivance, said to be still used in England, for scooping out the earth in certain situations to form the channels for canals or aqueducts. His elaborate volume on canal navigation appeared in 1796, the calculations and drawings comprised in which must have occasioned great labor. Soon after this he obtained a patent for his canal improvements from the English Government, as he also did from the French.

In France, as early as 1797, we find him making his first experiments, on the river Seine, with a machine intended to give to carcasses of gunpowder a progressive motion under water, to a certain point, and there to explode them. This was the first experiment made in pursuance of his plans of sub-marine navigation. It did not succeed to his satisfaction; but it was followed up by a series of calculations and contrivances which resulted, four years afterwards, as we have heretofore seen, in the most gratifying and brilliant success.

Connected with the *nautilus*, or plunging-boat, were what he then termed sub-marine bombs, and to which he afterwards gave the name of *torpedo*. Satisfied with the performance of his boat, he proceeded to make experiments in the harbor of Brest, with the bombs. A small shallop was anchored in the roads, with a bomb containing about twenty pounds of powder. He approached to within about two hundred yards of the anchored vessel, struck her with the torpedo, and blew her into atoms. A column of water and fragments was blown from eighty to one hundred feet in the air. This experiment was made in

the presence of the prefect of the Department, Admiral Villaret, and a large number of spectators.

High expectations were entertained of both the inventions just mentioned as warlike instruments; and France and England being at this period engaged in war with each other, it was confidently hoped that Fulton, who might be considered as in the service of the French Government, would be able to operate advantageously upon the numerous vessels of the enemy which covered the channel. 'We have not succeeded in steering the balloon'—we quote from a communication in the Paris Journal of Commerce dated January the twentieth, 1802—'and even were it impossible to attain that object, the case is different with the diving-boat, which can be conducted under water in the same manner as upon the surface. It has the advantage of sailing like the common boat, and also of diving when it is pursued. With these qualities, it is fit for carrying secret orders, to succor a blockaded fort, and to examine the force and position of an enemy in their harbors. These are sure and evident benefits, which the diving-boat at present promises. But who can see all the consequences of this discovery, or the improvements of which it is susceptible. Mr Fulton has already added to his boat a machine, by means of which he blew up a large boat in the port of Brest; and if by future experiments the same effects could be produced in frigates or ships of the line, what will become of maritime wars, and where will sailors be found to man ships of war, when it is a physical certainty that they may at every moment be blown into the air by means of diving-boats, against which no human foresight can guard them. These were the observations of St Aubin, a distinguished member of the French Tribunate in 1801, and they may probably be regarded as a fair illustration of the state of public opinion, at least among the scientific, in regard to Mr Fulton's experiments.

The inventor made several attempts to avail himself of some opportunity of proving, at the expense of a British vessel, that the expectations formed of his machinery, were not without reason. But in this instance again he was unsuccessful. He watched the English navigation

upon the French coast, during the whole season of 1801; but though some of their ships daily approached off the harbor of Brest, where he seems to have stationed himself, yet none came so near, or anchored in such a situation, as to be exposed to his attempts. In one case, he came very near a British seventyfour, but she just in time made such a change of position as to save herself. The French ministers were so much discouraged by this want of success, that they not only declined to make further advances for new efforts and experiments, but showed a disposition not to fulfil the engagements they had already made.

Meanwhile, the English had received some information of the extraordinary attempts which their enemies were making, and just at the period when Fulton was compelled to renounce the patronage of the French Government. The greatest uneasinesss was felt concerning him and his invention in the neighboring country. Lord Stanhope, who must have known of how much the genius of Fulton was capable, spoke of them with evident anxiety in the House of Lords. In 1803, he formed an association of gentlemen, for the purpose of procuring information as to the progress of the inventor's designs, and what might be their probable consequences. This association made a report to the British minister, Lord Sidmouth; and this led to a communication from him to Mr Fulton, the object of which was to deprive France of the benefit of his services, and to give England the advantage of them by inducing him to withdraw to that country.

Fulton entered into a negotiation, accordingly, (for which he has sometimes been rather hastily censured). He made it perfectly understood, however, that he was not about to comply with the English proposals as an English partisan. His only object — and he believed that this object was of such a character as to justify him in taking the step which he did — was to try in practice a theory which, if it were just, the English must have perceived as well as himself, would essentially put an end to their maritime superiority, whatever temporary advantages they should reap from it. The importance attach-

ed to his labors, in their view, may be still better estimated from the circumstance, that they proposed to give him a considerable reward for absolutely *suppressing* his invention, so that neither his own nor their country, nor any other, should derive from them the advantages which they seemed likely to afford. This overture he rejected with indignation. 'At all events,' he says in his communication to the committee appointed by the British ministers to confer with him, 'whatever may be your reward, I never will consent to let these inventions lie dormant, should my country at any time have need of them. Were you to grant me an annuity of twenty thousand pounds a year, I would sacrifice all to the safety and independence of my country.'

Soon after this letter was written, Mr Fulton visited London. In May, 1804, he had an interview with Mr Pitt, who was then in the administration, but without any result of importance. A commission of men of science was indeed appointed in June, to examine the new projects; but it was not difficult to be seen from the first that the chief purpose of the ministry was to assure themselves that it should not be used or encouraged at all by any nation, and especially by the French. 'If introduced into practice,' said Mr Pitt upon the first minute and distinct information he received of the plan, 'it must annihilate all military marines. Lord Melville, another of the ministry, condemned it, without a moment's consideration, at the interview already spoken of between Mr Fulton and Mr Pitt. The object of the commissioners, in accordance with the same policy, seemed to be rather to give the invention, as widely as they possibly could, the character of a chimera, than to examine its merits or confer with its author. Some unsatisfactory experiments were made under their control; but Mr Fulton was called upon for no explanations, and the commissioners reported against the practicability of his scheme.

That this decision was predetermined in a great measure, or at least determined against evidence, appears from the fact that Fulton not only demonstrated the cause of *their* failures, but himself undertook to prove, and did

prove, the efficacy of his engines. On the fifteenth of October, having obtained the assent of the ministry to make the experiment, he blew up a strong-built Danish brig, of the burden of two hundred tons, which was anchored for the purpose in Walmar roads, near Deal, and within a mile of Walmar castle, where Mr Pitt then resided. The following acount of this affair is taken from his letter to Lord Castlereagh upon the subject. 'Yesterday, about four o'clock, I made the intended experiment on the brig, with a carcass of one hundred and seventy pounds of powder, and I have the pleasure to inform you that it succeeded beyond my most sanguine expectations. Exactly in fifteen minutes from the time of drawing the peg, and throwing the carcass into the water, the explosion took place. It lifted the brig almost bodily, and broke her completely in two. The ends sunk immediately, and in one minute nothing was to be seen of her but floating fragments. Her mainmast and pumps were thrown into the sea; her foremast was broken in three pieces; her beams and knees were thrown from her decks and sides; and her deck-planks were rent to fibres. In fact, her annihilation was complete and the effect was most extraordinary. The power, as I had calculated, passed in a right line through her body, that being the line of least resistance, and carried all before it. At the time of her going up, she did not appear to make more resistance than a bag of feathers, and went to pieces like a shattered egg-shell.'

It may be interesting to some of our readers to follow Mr Fulton in his subsequent labors upon his submarine navigation. This subject, together with his steam machinery, almost exclusively occupied his attention from the period of his arrival in this country. Within a month, he offered his services to the American administration, having some reason to suppose that the state of our relations then existing with Great Britain in particular, might make it an object to bring forward his inventions. Meanwhile, he thought it well to acquaint his countrymen at large with the nature of his projects; and he invited the magistracy of New York, with a number of citizens, to Governor's Island, where were his torpedoes

and the machinery with which his experiments were to be made. A pleasant anecdote is told of this interview. His numerous auditors crowded around him to hear his lecture upon the large empty copper cylinders, which were his blank torpedoes. At length he turned to a copper case of the same description, which was placed under the gateway of the work, and to which was attached a clockwork lock. This, by drawing out a peg, he set in motion, and then said to his attentive audience. 'Gentlemen, this is a charged torpedo, with which, precisely in its present state, I mean to blow up a vessel. It contains one hundred and seventy pounds of gunpowder; and if I suffer the clockwork to run fifteen minutes, I have no doubt it will blow this fortification to atoms.' The circle in which Mr Fulton was, now began to enlarge rapid-and before five of the fifteen minutes were out, there were but two or three persons remaining under the gateway. Some, indeed, lost no time in getting at the greatest possible distance from the torpedo, with their best speed, and did not again appear upon the ground till they were assured it was lodged in the magazine. Indeed they did not seem to feel themselves quite safe, as long as they were on the island.

In pursuance of experiments which the Government authorized him to make, he blew up, with a torpedo, on the twentieth of July, 1807, a large hulk brig which had been provided for the purpose in the harbor of New York. The explosion did not take place until some time after the appointed moment, owing to a slight misarrangement in the machinery; but when it did take place, nothing was seen in the air but a high column of water, smoke and fragments. The delay arose from his having tried the buoyancy of his prepared carcasses in a tub of water, without having attached their locks, which were of considerable weight. When these were to be fixed to the floating carcasses, they covered them so that the locks were downwards; and when the hammer of the lock drove up the pan, the priming powder fell out, and the spark from the flint could have no effect.

Mr Fulton made some exertions to acquaint the members of Congress, at Washington, about this time, with

his projects. To many he explained them in private, as he also did to President Jefferson, Mr Madison (then Secretary of State) and various other eminent men; and such was the confidence in his schemes with which he inspired these gentlemen, that they soon procured from the National Legislature an appropriation of five thousand dollars for further trials of the torpedo. This being left to be expended at the discretion of the President, he proposed to Mr Fulton, that some preliminary experiments should be made in the harbor of New York; and the Secretary of the Navy was instructed to invite several distinguished individuals to be present, with a view of reporting to the Government. Among the number were Commodore Chauncey and Commodore Rogers. A brief sketch of the machines and models submitted to their examination by Mr Fulton, will serve to show at least, that he was still indefatigably employed, if not invariably or entirely successful.

The torpedoes, which he exhibited, were to be applied to the bottom of vessels in various ways. In the first place, two of them, united by a coupling line, were to be set afloat in the tide at a certain depth beneath the surface, and suffered to drift down on each side of the vessel to be attacked, so that the coupling line would be arrested by the cable of the vessel. This would occasion the torpedoes, pressed by the force of the current, to approach each other, and come in contact with the lower part of the vessel. Another proposal was, to fasten a torpedo to one end of a line, while the other end should be attached to a harpoon, which was to be discharged into the bows of the hostile vessel, from a peculiar piece of ordnance of Fulton's invention, carried on board of a light boat also constructed for the purpose. It was supposed, that this boat might venture near enough to an enemy to do the required execution, with at least as little danger as fire ships are generally exposed to, in effecting their object. The line being fastened to the vessel at one end by the harpoon, the current, if the vessel was anchored, or the progress of the vessel through the water, if she was underway, would bring the torpedo at the other end of the line under her bottom. The tor-

pedoes, when in this situation, were to be discharged by clockwork locks, or by locks so constructed that the triggers would be drawn by levers connected with them, coming in contact with the vessel. It was proposed to apply a torpedo, by having it attached to a long spar, which should be suspended by a swivel from the bowsprit of a torpedo boat, so nearly on a balance that a man in the bow of the boat could elevate or depress the torpedo with one hand, while with the other he could pull a string attached to the trigger of the lock, whenever the torpedo should be nearly under the bottom of a vessel.

Of all these projects, models were exhibited, but these were not all. The still unsatisfied and indefatigable inventor proposed to employ in his '*torpedo war*', (the title of a pamphlet which he published upon this subject) something which he called a block-ship. This was a vessel of from fifty to one hundred tons' measurement, the sides of which were to be cannon-proof, and the decks impenetrable to musket-shot. It was to be propelled by a machinery, worked by her crew under cover of the sides. On each quarter and bow was to be a torpedo fastened to a long spar, the inner end of which was to be supported and braced by ropes from the yards, like the lower steering sail-boom of a ship. The torpedoes were to be thrust under the bottom of the enemy's vessel, by means of these spars. There was afterwards a proposition to employ the common river-sloops in this scheme — their sides being lined with stout timber, and their decks covered with sheet-iron of a sufficient thickness. These, it was believed, might be navigated by their usual sails; and Fulton supposed, that of ten or twelve such vessels one might certainly approach a hostile man of war of almost any force, and this would be making her destruction inevitable. It would constitute an obvious objection to the plan, that the attacking vessels themselves, in case of a near explosion, would be exposed to the danger which they created. But this difficulty was foreseen, or rather it was seen to be without foundation. The inventor had long before ascertained, in the course of his experiments made in the roads of Bologne, that the force of gun-powder, exploded under water, always

operates perpendicularly to the surface. 'The lateral pressure of a great mass of waters' — we use the language of a writer familiar with this subject — "opposes an infinite resistance to a sudden impulse, and confines the course of an explosion in a line at right angles to the surface, as certainly as the sides of a cannon direct the force of a discharge in the course of its calibre.'

In addition to all these contrivances, chiefly designed for the defence of a sea coast, the *stationary torpedoes* were to be employed separately. These were carcasses of powder, as heretofore described, having levers attached to the triggers of the lock, so that numbers of them being anchored where a vessel was to pass, an explosion would be caused by the vessel pressing the lever as it passed over.

Some of these machines were to have been tried upon a vessel fortified against them, in the harbor of New York; and the sloop of war, Argus, then commanded by the gallant Captain Lawrence, was selected by Commodore Rogers for that purpose. But as Mr Fulton had minutely explained all his plans of attack to him — while these, on the other hand, must have been attended with some of the imperfections and awkwardness of all first attempts, conducted by men entirely unacquainted with the business — the experiment, if it could be called one, was hardly satisfactory. Indeed, upon witnessing the preparations for defence made by Commodore Rogers — and of which he had no previous intimation — the attack was immediately given up. A strong netting had been suspended from the sprit-sail of the sloop of war, which was anchored at the bottom. She was surrounded by spars lashed together, which floated on the surface of the water, so as to place her completely within a covert. Besides this, there were grappling-irons, and heavy pieces of the same metal, suspended from her yards and rigging, ready to be plunged into any boat that came beneath them; while great swords or scythes, moving at the end of long spars like sweeps, added not a little to the terrors of this formidable defence.

Of the gentlemen requested to give their opinions of the plans of Mr Fulton, Chancellor Livingston, Governor

Lewis, and Mr Colden of New York, reported in the most favorable terms. 'Upon the whole,' says the former, 'I view this application of powder as one of the most important military discoveries which some centuries have produced. It appears to me capable of effecting the absolute security of your ports against naval aggressions,' &c. 'I might add,' writes Mr Lewis, a gentleman of distinguished military experience, 'that they warrant an expectation, that the submarine use of gunpowder will, at no distant period, be entitled to rank among the best and cheapest defences of ports and harbors.' Mr Colden was still more sanguine; but the other individuals of the Committee, as also Commodore Rogers were unwilling to concur in any other opinion, than that the system submitted to them had as yet been too imperfectly demonstrated, to justify the government in relying upon it as a means of defence. In *this* decision, Mr Fulton himself concurred. 'It has never been my wish' — he says in a letter to the Secretary of the Navy — 'that such confidence should be placed in torpedoes, until fair experiment has proved their value beyond a doubt.' We may observe here, in leaving this subject, that such experiment never was made. The inventor's attention was, soon after this, extraordinarily engaged in other affairs and especially in his steam-boats. That his experiments continued, however, to excite some anxiety abroad as well as some interest at home, appears from a speech made in the English House of Peers about this time, by Lord Stanhope — there being then a prospect of a rupture between the two countries. 'It was not sufficiently known,' he said, 'that at this very moment exertions were making in America to carry into effect a plan, for the disclosure of which, an individual had a few years before demanded of the British Government fifteen thousand dollars, but had been refused. He alluded to a plan for the invisible destruction of shipping, and particularly of men of war. The inventor of this scheme was in America, *and it was ascertained that it would not cost twenty pounds, on an average to destroy any ship whatever.*'

We have omitted to notice one of Mr Fulton's inven-

tions, which was exhibited and explained to the commissioners; and with which he soon after succeeded in cutting off, several feet below the surface, a fourteen-inch cable, attached to a vessel anchored in the harbor for that purpose — an experiment which went also to prove that a gun might be fired under water with effect. This machine, called the *cable-cutter*, consisted of a large iron hook, upon the shaft or haft of which was placed a small piece of ordnance charged with powder as in the usual mode; and of an instrument with a chisel or cutter at the outward end, of a crescent form. The piece was to be discharged by a water-proof lock, like those used for the torpedoes. To the iron part of this machinery, was attached a sufficient quantity of wood or other buoyant substance, to support it, and from this substance the iron was to be supported by cords or chains, at any required depth. A long line was connected with one end of the shaft of the hook, and the other end of the line was fastened to a floating body. Thus prepared, the machine was to be thrown into the current at any distance, in the tide-way above the object of attack. The hook with its appurtenances being on one side, and the buoy at the other extremity of the line on the other side, the whole would be swept down by the current, until the line should be intercepted by the cable of the vessel. When in this position, the buoy was to draw the line across the cable till the hook embraced it, and then to drag the cable immediately before the muzzel of the piece of ordnance, and of course directly in opposition to the chisel or cutter. In this situation the cable would pass against a lever, which crossed the hook, and communicated with the trigger of the lock; the piece would be fired, and the cable separated by the cutter. It was well observed by one of the commissioners, respecting the principal inventions we have been describing, that although they should never be made so thoroughly efficient in actual attack as Mr Fulton confidently believed they might be, yet they would certainly be of no inconsiderable service even in compelling an enemy to embarrass himself with an unweildy defence. 'A vessel of war surrounded by large bo ms and spars, with nets, as deep as the water, hanging from

her bows, with her rigging loaded with heavy pieces of iron, with grapnel and shot suspended from her yards to guard against torpedoes, and with chains to guard her cables, must be much less formidable for attack or defence than she would be without such incumbrances.'

From the descriptions we have already given of Mr Fulton's contrivances for submarine navigation and explosion, those who are familiar with practical mechanics will readily conjecture how he was led on, in his investigations and his inventions from one step to another. But we have by no means arrived at the last term of this series. The commencement of hostilities between England and this country, in 1812, renewed his interest in certain pursuits which for an interval had been neglected. He proposed to Government, that a *marine corps* should be exclusively drilled in the management of the torpedoes — a measure evidently indespensible to a fair trial of them on a large scale — but his project was not adopted and the inventor's thoughts took a new direction. He had ascertained, as we have seen, that a piece of ordnance might be discharged effectually under water. Hence he conceived the idea of forming *submarine batteries*. The calculations and experiments which he instituted upon this subject, are worthy of notice, as specimens both of his ingenuity and his science.

He assumed, that a body passing through water would meet with a resistance equal to the force of a column of water of the same diameter as the body moving with the given velocity. He then ascertained what head or height of water would be required, to discharge a stream of water from an orifice at the foot of a perpendicular tube, with the same velocity with which the body was supposed to be propelled. By well known rules of hydraulics, he then found what force of power the ascertained head of water would give, and thence formed his estimates as the resistance which a body projected in water would meet with. Having reduced his calculations down to a rule sufficient for all practical purposes, he began his experiments with a four-pounder, having the breech and as much of the gun as is usually within the

sides of a vessel, inclosed in a water-tight box, and the muzzle stopped with a tompion. The box and gun being then submerged three feet in the Hudson, the gun was fired by dropping a live coal through a tin tube which penetrated the box immediately above the vent of the gun, and rose above the surface of the water. The ball was found to have struck the sand on the bottom of the river, at the distance of fortyone feet from the muzzle, while the gun itself remained uninjured.

This experiment satisfied him that guns might be placed in a ship below her water-line, with their breech on board, and their muzzle in the water; and thence arose his famous idea, which has not heretofore been commented upon, of arming ships with guns to be furnished and discharged in this manner. Thus it was that in his restless and powerful mind, one discovery was continually leading to another; and thus was he continually compelling himself to labor upon the intermediate and subordinate minutia. In this instance, he proposed that the muzzle of his gun — and this was made for his purpose — should recoil through a stuffing-box, and be followed by a valve which would exclude the water when the gun was not protruded. He next tried the same piece tried before, with a pound and a half of powder, and fired it by means of one of his water-tight locks, when it was entirely in water, three feet below the surface. The ball penetrated eleven and a half inches into a target of pine logs, placed under water, at the distance of twelve feet from the piece. He also discharged what is called a *columbiad*, carrying a one hundred pound ball, the effect of which was to tear the target to pieces. Mr Fulton proposed to use these cannon, in war-time, by suspending them from the bows of the vessel — the machinery admitting of their being hauled in whenever desirable. He believed, and indeed demonstrated, that a single shot from a piece of considerable calibre, which should break into the side of a ship, at any great depth below the water-line, would be fatal to her; and he well knew that conflicting vessels are very frequently so near each other (engaged yard arm and yard arm is the phrase) as to allow his submarine guns

all the opportunity they required. This plan was submitted to one of our most distinguished naval commanders, and he expressed a very favorable opinion of it; as did Mr Jefferson also: who proposed to recommend it to the attention of Government.

Another proposal regularly arrived at, like all the preceding, in the course of research and reflection — was to plant batteries of submarine guns near the channels through which hostile vessels must pass into American sea-ports. But what is more to our present purpose, the submarine guns gave rise to that magnificent and beautiful monument of ingenuity, *the steam man-of-war.* The immediate occasion of this construction, was to obviate an objection, made by the naval gentleman first refered to, against the cannon we have been describing — that the ordinary rigging of a vessel which carried such ordnance, would make her liable to be entangled with her adversary. From this moment, Fulton resolved to construct a vessel of war which should possess all the advantages of common ones, with the additional one of being propelled by steam. This grand experiment was encouraged upon all sides, in a manner that was as honorable to the country as it was fortunate for the inventor. The whole project having been matured and illustrated with models, in the usually luminous and laborious manner of Mr Fulton, was submitted to a large Committee of distinguished naval commanders (appointed by the citizens of New York) among whom were Commodores Decatur and Perry, and Captains Jones, Evans, Biddle, Warrington and Lewis. These gentlemen unanimously reported in favor of the project. They also recommended it to Congress in a memorial, and at the same time particularly solicited the notice of the Secretary of the Navy. Moreover, although the proposed vessel was estimated to cost three hundred thousand dollars, they offered to erect her at their own expense, provided the Government would purchase her in case of their success. But there was no deficiency of funds. The Executive (Mr Madison) zealously embraced the project; and Congress in March, 1814, authorized the expenses necessary for the experiment. The building of the vessel was undertaken

by five gentlemen, General Dearborn, Col. Rutgers, Oliver Wolcot, Dr Samuel L. Mitchel, and Thomas Morris; and Mr Fulton, without whom nothing could be done, was officially appointed the head engineer.

The keel of the new vessel was laid June the twentieth, 1814, and upon the twenty ninth of October she was launched. 'The scene exhibited on this occasion' — we are informed by a spectator —' was magnificent. It happened on one of our bright autumnal days. Multitudes of spectators crowded the surrounding shores, and were seen upon all the hills which limited the beautiful prospect. The river and bay [of New York] were filled with vessels of war, dressed in all their variety of colors, in compliment to the occasion. In the midst of these was the enormous floating mass, whose bulk and unwieldy form seemed to render her as unfit for motion as the land-batteries which saluted her. Through the fleet of vessels which occupied this part of the harbor, were seen gliding in every direction, several of our large steam-boats of the burden of three and four hundred tons. These, with bands of music, and crowds of gay and joyous company were winding through passages left by the anchored vessels, as if they were moved by enchantment. The heart could not have been human that did not share in the general enthusiasm expressed by the loud shouts of the multitude. He could not have been a worthy citizen who did not then say to himself, with pride and exultation, *this is my country!* And when he looked on the man whose single genius had created the most interesting objects of the scene, *this is my countryman!*'

This noble vessel, which was named Fulton the First, was never tried in the life time of the inventor. He died, as it were, precisely upon the consummation of this most magnificent monument of his genius. It followed, necessarily, that many imperfections in the vessel remained unremedied. Her performances, however, more than equalled the promises he had made to the Government.

July the fourth, 1818, she made a passage to the ocean and back, of fiftythree miles in eight hours and twenty minutes, by the mere force of her engine. In September, some improvements having been made in

her, she performed a voyage at the rate of five and a half miles an hour on an average, with and against the tide, having her entire armament on board. The inventor had promised the Government, that her speed should be from three to four miles.

We presume that some description of this vessel will not be without its interest to our readers. She was a structure resting on two boats and keels, separated from end to end by a channel fifteen feet wide and sixtysix long. One boat contained the copper cauldrons for preparing her steam; and the other her cylinder of iron, its piston, levers, and wheels. The water-wheel revolved between the two. The main or gun deck, supporting the armament, was supported by a parapet four feet ten inches thick, of solid timber pierced by embrasures. Thirty port holes were provided for as many three-pounders, intended to fire red hot shot — a safe and convenient heating furnace being a part of the interior system. The upper or spar deck, large enough for the parade of several thousand men, was encompassed by a bulwark, affording safe quarters. Two stout masts supported each a latteen yard and sails. There were two bowsprits and jibs; and four rudders, one at each end of both boats, so as to steer the boat equally well with either end foremost. Mr Fulton had prepared the machinery for the insertion of an additional engine, intended to discharge a column of water upon the decks and through the port holes of an enemy; besides all which he proposed to suspend two of his one hundred pound columbiads from each bow, for firing balls of that size into an enemy's ship, at ten or twelve feet below her water-line. The measurement of this immense vessel was two thousand four hundred and seventyfive tons.

A collateral project of the unwearied artist, — left incomplete at his death, and never finished — was a curious modification of his submarine boat, a model of which having been submitted to the Government, he was authorized to commence building at the public expense. We cannot refrain from gratifying our readers with a sketch of this plan. It was a vessel made capable of being submerged in the water more or less, without sink-

ing her deck, by means of one of his nautilus air-chambers. This chamber, communicating with the water and shaped like a diving bell, could be exhausted of air by an air-pump, at pleasure, and then would of course fill with water, as on the other hand any requisite quantity of air could be forced into it to the exclusion of the water. The deck was made ball-proof by iron plating. She was to be of a size to shelter one hundred men under her deck and was to be moved by a wheel placed in a second air-chamber near the stern. Fulton supposed that fogs or darkness would always enable her to approach an enemy undiscovered, so as to do execution by means of his submarine guns. It is a singular fact that, much as this ingenious project was approved of, the death of Fulton compelled the Government to abandon it.

Such was the life and such were the labors of this wonderful man. We have by no means enlarged upon the latter as even our slight resources allowed us; nor is it at all possible to do justice to any one of his grand inventions, without the models and drawings and demonstrations, which himself only could furnish. But we have enumerated, if not explained, enough to justify whatever has been said of his industry, his energy, or his intelligence. What he might have done farther, had he been spared (had he spared himself, we may say) it is wholly impossible to calculate. Fortunately it is enough for his fame, as it weree nough for the fame of any man, that he achieved the indisputable discoveries and improvements, theretical and practical, which are universally ascribed to him, and respecting the authorship of which there can be no more controversy than there can be respecting the ingenuity or their value to mankind. The application of steam to the navigation of vessels will alone be sufficient to immortalize him in the most certain and extensive, as well as the most honorable manner. Ages hence, when the praise of many a renowned scholar and statesman shall have ceased to dwell upon the tongues of men, the name and the memory of Fulton will be repeated and revered as those of *a citizen of the world.*

SCIENTIFIC TRACTS.

VOL. II......NO. VI.

VOLCANOES.

EXPLOSIONS IN COAL MINES.

VOLCANOES are the most interesting of the phenomena of the earth, as being most impressive in their appearance, extraordinary in their effects and mysterious in their origin. The term is derived from the name of Vulcan, the god of fire, who was supposed by the ancients to forge the thunderbolts of Jupiter in Ætna's furnace. Volcanic eruptions are intimately connected with physical geography and the science of geology.

GEOGRAPHY OF VOLCANOES.

It is supposed that the number of active volcanoes in the world is one thousand, if we include all those still retaining some degree of heat, although at present dormant. The number however of known burning volcanoes is estimated at two hundred, which are distributed as follows. *One* on the continent of Europe and twelve on its islands, sixtysix in Asia, one hundred and seventeen in America, and an unknown number in Africa. The number now is not so great as in ancient times. The whole face of the earth exhibits appearances to lead the geologist to believe, that they were once not only more frequent than at present, but that their eruptions were on an incomparably larger scale. The number of *extinct* volcanoes which are known exceeds that of the active. Many may have been covered up by the eruptions of succeeding volcanoes. In a district of forty miles square

near Naples there can be seen sixty extinct volcanoes. Cumea, a city founded 1260 B. C. is built in the crater of a previous volcano. In Auvergne in France the vestiges of extinct volcanoes cover a tract of country several thousand leagues in extent. The period at which they occurred is so far distant, that no record of history contains any information concerning them. Their lava appears as fresh as those of modern volcanoes, and their craters are in a measure perfect. The craters of Vesuvius, of Ætna and of Teneriffe are within the bosom of previous larger craters. The whole of the mountainous parts of Quito are considered, by Humboldt, as one immense volcano, occupying more than seven hundred leagues, and throwing out lava by different cones.

In considering the geography of the two hundred burning volcanoes, they may be viewed as acting in chains, in groups or isolated. The most remarkable series of volcanoes, extending like a *chain* around the continents, is that beginning at Terra del Fuego, the 'Land of fire,' passing up through the Cordilleras of South America, Nicaragua, Guatimala, Mexico, to California. It thence continues northerly along the western coast of North America, and is connected with the continent of Asia by the Aleutian isles. It proceeds thence down from Kamschatka to Japan, the Phillipine isles, to the Moluccas, and here takes a westerly direction to Timor, Java and Sumatra, terminating at the Nicobar isles. Smaller extinct chains embrace France, Germany and Italy. As existing in *groups*, the volcanoes of the Azores, the Canaries, Iceland, and the Cape Verd islands may be mentioned. These groups are virtually one volcano, possessing only several vents for the eruptions. Instances of *isolated* volcanoes are Ætna, Vesuvius, and the Peak of Teneriffe. Submarine volcanoes often occur, but many cannot be observed on the ocean, and of course we know the locality of but very few.

PHENOMENA OF VOLCANOES.

A volcanic eruption is usually preceded by earthquakes of different intensity and duration, with loud

sounds resembling the noise of musketry, and bellowings prolonged for days in the sides of the mountain. The atmosphere possesses remarkable stillness, and produces a sense of oppression. Springs throughout a large extent of country are likely to disappear and the wells to become dry. The ocean sometimes seems to retire from the shore. The surface of the ground becomes heated, and swells upwards like a plastic mass, or heaves like the waves of the sea, till a rent is formed in the ground extending the whole length perhaps of the agitated land. Through this chasm, masses of rock with flame and smoke and lava are thrown up, which often fall back and choke the fissures so as to confine their passage to one or more apertures. Around this the ejected matter is deposited in conformity to the usual laws of gravitation, forming, according to the situation of the scene, mere channels or conical hills. The cones are usually hollow, of a circular or elliptical form, and the concavity is termed the crater. After such a crater has been formed, the volcano may be dormant for years, or centuries. At length however an approaching eruption is foretold by the usual signs before mentioned, and also by an increase of smoke from this orifice, which will often rise to a vast height. Fragments of rock are ejected, clouds of aqueous vapor issue forth. At times lightning of great vividness proceeds from the volumes of smoke, and the ashes or sand and dust projected, added to the density of the cloud, involve the surrounding country in darkness. The melted rock or lava now boils up in the crater, flows over its edge, and rolls on in waves, covering the neighboring plains with the melted matter, sometimes several hundred miles in extent and several yards in thickness. As the force is not equal always to raising a column of lava to such immense heights, instead of rolling from the crater, it issues through fissures in the sides. The greatest eruptions of Ætna and Vesuvius are always from the sides of the mountains: and some of the volcanoes of South America from eighteen to twentytwo thousand feet high, very seldom send anything but mud,

sand and ashes from their craters, while the lava is poured out at lateral openings.*

These eruptions are at their crisis when the lava has been flowing for a short period; but even when it has ceased to flow, intensely black clouds of dark colored sand or powder are thrown out and sometimes produce total darkness at noon-day. An eruption in Iceland covered Europe with haze for months. On the occasion of an eruption at Sumbawa, 'the sky at Java, three hundred miles distant, was overcast with clouds of ashes at noonday: the sun was enveloped in an atmosphere whose "palpable density" was impenetrable: showers of ashes covered the house tops, the streets and the fields to the depth of several inches.' In the night these eruptions are occasionally luminous to such a degree that a person has been able to read by the light at 12 miles' distance.

Volcanoes may be divided into two classes, according as their eruptions are permanent or occasional.

Permanent. Stromboli is constantly burning, one reason of which may be its low situation. The crater is inclined towards the sea, whither its products, continually rising, are always thrown. The pumice used in the arts, is mostly obtained here. Nicaragua is another continual burning volcano. Kirauea in the island of Hawaii, is now admitted to be the most wonderful volcano in the world. Rev. C. Stuart's description of a visit there contains the following. 'Standing at an elevation of one thousand five hundred feet, we looked into a black and horrid gulf from the highest part from fifteen to twenty miles in circumference so directly beneath us that in appearance we might have plunged into its lowest depth. When you add to the sight of the hideous immensity itself, the appalling effect of the various unnatural and fearful noises — the groaning and blowing — the very agonized struggling of the mighty action within — as a whole it is too horrible. The crater differs from other craters in that it is approached not by ascending a cone but by descending two vast terraces, which is probably the hollow of the old crater now fallen in. The

* Bakewell and Jour. Roy. Inst.

gulf contains fiftysix conical craters. As night approached, they became luminous one after another, glaring widely over the surrounding obscurity against the tides of the ledge and cliffs. Rivers of fire were seen rolling in splendid coruscations among the laboring craters. And on one side there was a whole lake, whose surface constantly flashed and sparkled with the agitation of contending currents. * * * * * It was not less than two miles in circumference, and its action was more horribly sublime than anything I had ever imagined to exist, even in the ideal visions of earthly things. Its surface had all the agitations of the ocean; billow after billow tossed its monstrous bosom in the air, and occasionally those from different directions met with such violence as in the concussion to dash the fiery spray forty and fifty feet high. It was at once the most splendidly beautiful and dreadfully fearful of spectacles.' This volcano has been visited by other travellers, by whom this account is confirmed.

Occasional. With some volcanoes, there is an interval of many years between the eruptions. Ætna and Vesuvius have been dormant for centuries; but Ætna since 1800 has had five eruptions. Teneriffe had a peace of ninetyseven years, and it was after an interval of more than a hundred years, that Vesuvius in 1306, destroyed and scattered the rich growth of groves that had been flourishing in her crater during the intermission.

An interesting phenomenon attending volcanoes is their engulfing their own craters. The island of Timon contained a volcano which is now a lake, and many of the lakes of Italy give evidence of having been formed in the same way. Paypandayung, the largest volcano in the island of Java, was swallowed up in this way, after a volcanic eruption.* The account states that near midnight, Aug. 12, 1772, there was observed about the mountain an uncommonly luminous cloud, by which it appeared to be completely enveloped. The inhabitants were alarmed and endeavored to flee, but before all could save

* Raffles' History of Java.

themselves the mountain fell in and disappeared in the earth. It is estimated that an extent of ground fifteen miles long and six broad was, by this commotion, swallowed up in the bowels of the earth.

SUBMARINE VOLCANOES.

Many volcanic eruptions are supposed to occur, of which the knowledge cannot reach us, either because the craters are so deep in the sea, that the materials of the eruption do not appear upon the surface, or else because when the eruptions occur no navigator is near to notice them. The same causes which operate to produce volcanoes on land throw up matter also at sea. All insular volcanoes have originally been formed by matter thrown out from submarine vents. Many of the islands that have thus been thrown up have soon disappeared. An island emerged from the ocean near the Azores, nine miles square, which remained a few months and then sunk, leaving eighty fathoms of water above it.* An eruption of flames from the sea commenced near Iceland in Jan. 1783, which continued for several months, shaking the island with earthquakes. When these flames ceased, the Shapta Yokul, two hundred miles inland, broke out with the most tremendous eruptions ever recorded: the inhabitants did not see the sun during the remainder of the summer, — and all Europe was covered with haze. Near the island of Sautorini in the Mediterranean there was a subterraneous volcano that sent up such vast quantities of pumice stone (which is so light that it floats on the water,) as to cover the sea and choke the entrance to the harbor, so that neither ships nor boats could pass through.

EARTHQUAKES.

Earthquakes are universally admitted to be of the

* Graham island which lately arose in the Mediterranean and was claimed as the property of England, France, and Sicily, is said also suddenly to have disappeared.

same class of phenomena as volcanoes. They are both caused by internal heat, but are different exhibitions of the same power. They are preceded by the agitation of the ocean ; springs become muddy, a deep rumbling noise — a rushing sound like a mighty wind or a tremendous explosion like the sound of artillery, immediately precedes the shock, which suddenly heaves the ground upwards or tosses it from side to side with violent and successive vibrations. Large chasms are formed, which eject stones and water. These chasms are sometimes of such immense size as to receive whole cities. Euphemia in Calabria, after a violent paroxysm of the land sunk into a frightful chasm, and nothing but a dismal and putrid lake remained to tell where the city stood. The city of Antioch, A. D. 520 was once overturned by a dreadful earthquake, and two hundred and fifty thousand of its inhabitants were buried in the ruins. A raging fire covered the district on which the city was built and the country around, spreading over an extent of territory fortytwo miles in diameter, and a surface of fourteen hundred square miles.

Earthquakes are observed to be the universal precursors of volcanic eruptions. After an explosion the shocks gradually cease to be felt. It is from these observations that we infer a connexion between the two phenomona. The probable explanation is the following. The vapors known to be generated in the cavities of the earth are of a nature extremely elastic, and these we may suppose engaged in perpetual struggles for release. The violence of the agitation, from time to time produced, is proportional to the resistance which they meet in their passage. In the neighborhood of a volcano they find successively the same channel of discharge through its crater, and when a free passage is thus obtained the agitation gradually subsides. The vapors must sometimes roll to a great distance in search of a place of discharge, and thus they may occasion a trembling motion throughout the regions which are not the seat of volcanoes. But it is in the vicinity of volcanoes that the agitations are the most violent.

On the 24th of March, 1812, the city of Caraccas was overthrown by an earthquake, and in a few days after the volcano of St Vincents, which had been silent for nearly a century, broke out with great fury. The Ohio and Mississippi valleys were agitated to a considerable degree in 1811 and 1812, by earthquakes.

HOT SPRINGS.

These have their origin also from volcanic action. This is evident in part from their prevalence in volcanic countries. They are very abundant in Italy and Mexico. Jorullo has a hot sulphurous spring, which supplies a river a rod and a half wide. The qualities of some have not varied since the time they were known among the Romans, while others have been deprived at once of their heat and peculiar properties by earthquakes. They derive their qualities from the condensation of the gas or vapor, which exists at such a depth beneath, as to aid in preserving their unvaried temperature. It is a tranquil mode provided for the escape of the elastic fluids in the bosom of the earth. Some are regular, others irregular or intermittent.

The *periodical* springs rise and fall regularly, as one at Bolmas in France, eight times in an hour; others rise and fall with the tide, though in the interior of continents. Of the springs that flow at regular intervals, the Geysers of Iceland are the most remarkable. These wonderful spouting springs are well described in Henderson's Iceland. There are a great multitude of boiling springs at this place, of which Stroekr and the Great Geyser are the most noticeable. The Great Geyser is situated in a circular mound, with the cavity spreading at the top in a tunnel form. A cylindrical pipe of of seventyeight feet of perpendicular depth affords a channel to the boiling water. On flowing from the mound it passes through a turfy kind of soil, and by acting on the peat, mosses and grass furnishes the finest specimens of petrifaction. Its spoutings are but three or four times in a day. The ground adjacent is slightly agitated, — an ebullition commences, and gradually the water rushes up fifteen,

fifty, seventy, and sometimes one hundred feet. The column of water, ten feet in diameter, rises perpendicularly, and at the top spreads out into beautiful ramifications. Stones which he threw in, were thrown up by the water to the top of the jet, and there were tossed about for some minutes, falling down repeatedly upon the spout. Stroekr is called the New Geyser, — its violent eruptions being of modern date.

During the dreadful earthquakes in Iceland, 1784, this spring was observed to gush out with uncommon violence; and thirtyfive new spouting springs were also formed. Mr Henderson found that by throwing large stones into this he could cause the fountain to play when he pleased. He thus *caused* it to elevate the jets more than two hundred feet and some of the stones even higher. Vast clouds of steam make their escape during the eruption, and roll and spread as they ascend, so as to fill the whole horizon. The thermometer ranges from 175° to 200° of Fahrenheit. On the brow of the hill, at the height of two hundred feet above the Great Geyser, are several holes of boiling clay, some of which produce sulphur, others an efflorescence of alum.

PRODUCTS OF VOLCANOES.

The substances thrown out of volcanoes may be classed as *gaseous*, *inflammable*, *saline*, *metallic* and *earthy*.

Gaseous. Sulphuretted hydrogen and carbonic acid gas are thrown out in great quantities; others are nitrogen, ammoniacal muriatic and sulphuric acid *gas.* — Water is frequently sent up in the steam.

Inflammable. Sulphur is found sublimed in the fissures of the cones, and furnishes larger portions of that which is used in commerce. The Lipari isles and Kirawea at the Sandwich Islands furnish abundant specimens. Phosphorus, and carbon exist also in the craters.

Saline. These are sal ammoniac, common salt, green and blue vitriol, alum and gypsum.

Metallic. These are antimony, copper in pure state, gold very rarely. There is a mine of mercury in the crater of a volcano in S. America. Iron is a component

part of lava of which on an average, it forms one eighth part.

Earthy. These form the great body of the materials ejected. *Lava* is the most prominent, which boiling out of the crater, rolls down the mountain with a velocity in proportion to the steepness of the declivity. This molten flood rolling miles in width, is yet of such a consistence that when moving at the rate of a mile an hour, large stones thrown on it make no impression. Herculaneum and Pompeii were overwhelmed by an eruption of Vesuvius, A. D. 79. Herculaneun is imbedded to the depth of seventy feet in solid lava, and Pompeii in ashes and sand. The heat of the lava is very intense, and so much so that it requires many years for the entire mass to cool. The lava ejected by an eruption of Ætna in 1669, is still warm; in 1809, it smoked when it was wet with rain, and when perforated by digging, sent forth flames.

Stromboli, which throws from its *crater* scoriæ only, from its *side* sometimes sends lava into the sea in such quantities, and such intense heat, that the sea becomes very considerably heated.

The weight and form of lava varies much, although there is a general identity in all lavas. The heaviest lava is called basalt or trap-rock, which is composed of augite, hornblende, mica, and iron. The lightest lava is called trachyte, in which other minerals are rare, and feldspar is almost the sole ingredient. The external structure is either porous, compact, or cavernous. The last variety seems to be the effect of gas contained in the lava when heated, which has swelled it into bubbles, sometimes forty or fifty feet in diameter The minerals contained in these cavities are zedlites, calcareous, spar and chalcedony, grains of iron, sand and mica. The less glassy lava is decomposed after it has hardened into stone, and the surface becomes a fruitful soil. All lavas are not however subject to this change. Iceland lava of 3000 years old presents all the freshness of a recent eruption, while in Italy, in a few years the land can be recovered by planting the prickly pear in crevices, whose roots gradually spread and literally pulverize the rock.

Obsidian is a black or dark volcanic glass, which is not found with all lava, and seems to be produced by a sudden cooling of the melted matter. Pitch stone is very analogous to it in character and appearance. They are found at a distance from volcanoes, in fields, in isolated rocks and in mines, and are used for spear heads, knives, mirrors and ornaments.

Pumice is trachyte which had been exposed to an intense heat. The island Lipari is entirely composed of it, and that which is used in commerce is obtained there. 'The mountain is not one compact mass, but it is composed of balls or globes of pumice aggregated together, but without adhesion. It is sometimes fibrous or porous, at others apparently compact. They are never so compact as to prevent their swimming on water. Their fibres have been found on the Andes, eight or ten toises long. Pumice is not thrown out by all volcanoes, and by none till after the flowing of the lava.'

Volcanic *sand* or *ashes*, is lava and pumice powdered, *Scoriæ*, or dross, are slugs, heavier than pumice, which constitute the upper current of the lava. *Tufa* is the sand and ashes agglutinated by water, which often becomes hard enough for building stone. The soft tufa forms a mortar; the argillaceous matter it contains, when mixed with lime, consolidates under water, producing the Roman cement. The quantity of matter thus thrown out in the state of ashes, sand and powder, often exceeds that ejected in the state of lava.

Besides these products above described which are peculiarly the effect of volcanic fire, other substances are ejected far different in their origin. The volcanoes of the eastern continent, but much oftener those of the western, throw up mud and water. Macaluba, in the island of Sicily, from the crater half a mile in circumference sends up at times a fountain of mud, water and stones, two or three hundred feet in the air in a solid column, spreading at the top like a water spout from the ocean. Taman near little Tartary has given passage in a single eruption to one hundred thousand cubic fathoms of mud. A mud volcano in the island of Java embraces a crater two miles in circumference, in which lake of mud bub-

bles would form fifteen feet high seven or eight times a minute, and send up two or three tons of mud. The volcanoes of the Andes, though they send up more frequently water and mud than lava, yet are designated as fire volcanoes. The proper mud volcanoes send up nothing of the nature of lava, and the mud and water are always cold in every part of their craters: but that of the Andes is in a boiling state. The water probably finds access to the lava either from the sea or from lakes, for it is a remarkable circumstance that all the volcanoes at present in a state of activity are situated near the shore of the sea or of a lake. Vesuvius has sometimes thrown up salt water. Sometimes the water comes from subterranean lakes. On occasions of such eruptions, immense quantities of fishes have sometimes been driven out, designated by Humboldt *pimelodes cyclopum*. The number has been said in some cases to be so great that they have contaminated the surrounding atmosphere in their putrefaction, causing maladies among the inhabitants of the country adjacent. They are supposed to proceed from the lakes and rivers situated in the cavities of the mountains. Through the influence of internal heat, these are sometimes broken up, and their waters flowing to the crater are thence ejected with the other matter.

The deposits of mud, designated on the Rhine as *trass* and in America as *moya*, are called eluvial. Sometimes in drying, they *set* so firmly, owing to the bitumen they contain, as to be used for building stone, as the tufa which is used at Rome. The moya of the Andes also consolidates, and is used like peat of the meadows, for fuel.

Fragments of rocks of immense size are often ejected, apparently torn from the sides of the crater by the force of the ascending fluid. They are of every variety of formation. These fragments alternately rise and fall back again into the crater, until they become completely pulverized in the operation. They have been sent up by the force of the escaping steam-bubbles from Vesuvius, four thousand feet above the top of the crater and six thousand above that of Cotopaxi. A stone measuring a thousand cubic feet has been propelled to a distance of three leagues.

CAUSES OF VOLCANOES.

Naturalists are agreed in ascribing these tremendous exhibitions to the united agency of fire and water. But the subject is very little understood. It is not known what is the origin or seat of the fire, or by what it is supported. The substance of the earth is known to consist to some extent of various combustible materials, such as bitumen, fossil, wood, turf and coal. There exists also considerable quantities of iron and sulphur. In a state of combination the latter substances become strongly heated when excluded from the air if they contain any moisture. An instance of this effect is afforded, by a common experiment. It was originally performed in the following manner. A chemist mixed several pounds of iron filings and powdered sulphur into a paste by means of water and buried it in an iron pot in the earth. In about an hour the earth swelled and cracked, and sulphurous vapors were exhaled; a subterraneous fire was produced by the chemical actions of the sulphur, iron and water.

These causes are however allowed to be inadequate of themselves to supply such vast fires. The most extensive beds of coal we know of are but a few rods in thickness, and sulphur, compared with the immensity of the other volcanic products, is but a rare mineral in the earth. Where then shall we obtain a supply of materials for the yawning lakes of Vesuvius, Ætna and Kirauea. We at once see they could not have come from the mountain itself, for then there would have been nothing to support the superficial strata, and besides, they have some of them thrown up, Ætna for instance, twenty times as much matter as the original size of the mountain. We are driven to believe that they come from an immense depth, and as we shall afterwards prove from one common point, the centre of the earth.

Cordier, a French philosopher, has proclaimed as his theory, that the whole earth, excepting a few miles of crust, is one entire mass of fire. Experiments on an extensive scale have he thinks established the fact that the tem-

perature of the earth increases gradually as we approach its centre. At the depth of ten thousand feet, according to his calculation, the heat is sufficient to boil water, and at sixty miles, the crust of the globe becomes liquid and consists of melted lava. To the geologist also, the occurrence of tropical remains of animals in northern climates, and the flatness of the earth at the poles and its protuberance at the equator affords additional evidence to him to believe, that the whole earth was once fluid from heat, and that it is now gradually cooling. In cooling of course there is contraction, and the melted lava pressed by this contraction is violently erupted. There is no reason why this contraction should be any otherwise apparent than in connexion with volcanic action, for if five eruptions should chance to occur in one year, each of 13,084,491 cubit yards (which is the greatest extent of any eruption) it would even then take a century to shorten the diameter of the earth, ·03937 of an inch.

Other philosophers observing the materials ejected, do not presuppose the existence of the fire, but merely endeavor to develope the process by which combustion may be effected, and explosive power brought into operation.

It cannot be doubted that water is an important agent in volcanic action. As before remarked, the greater part of the whole number of known volcanoes are near the sea-shore, and it is not improbable that the others were once so situated, as the former bed of the sea is known to have experienced a change either in situation or extent.

All the modern geologists, whatever theory they may adopt, agree in this, that the whole operation goes on at some point far in the interior of the earth. The reasons have been given why the eruption could not have proceeded from the mountain; we must resort then to central heat. All eruptions originate underneath granite, and of course below beds of coal and bitumen, as granite is the lowest rock of the globe. Whenever therefore a volcano sends up either of these, it must be considered as a *pseudo-volcano*, a combustion of a bed of coal but a few hundred

feet down, or as incidental to that particular volcano. It is an evidence of their coming from one centre, that the lavas that have flowed from the craters of volcanoes, have been similar in all the circumstances attending their convulsions, and that the appearance of lavas thrown up by volcanoes in different parts of the globe and different ages of the world has been always the same. The reduction in their number and quantity of product also seems proportionable in all parts of the world. A continual supply of caloric seems to be constantly passing off from the centre to the circumference in various forms, as in elastic vapor, lava, &c, whenever the nature of the superficial rocks, by reason of their fusibility or incumbent position allows of its transmission, or temporary vents are opened for its free escape. Whenever a supply of water has reached this melted matter, and old vents are reopening or new ones forming by the energy of the compressed gas, the volcanic phenomena exhibited show the extent of their operation. During the great earthquakes which destroyed Lisbon in 1755 and 61, Europe, Asia and America were all affected with subterranean agitations, muddy boiling of warm springs, drying up of wells, Ætna, which had not been active for eighty years, broke out; Mexico was filled with earthquakes and volcanic eruptions. In Sept. 1759, the volcano of Jorullo, near the town of Mexico, broke forth, on a plain surrounded by mountains and one hundred and twenty miles from any volcano, preceded as usual by subterranean noises; there were tremendous earthquakes, and a 'tract of ground from three to four miles square rose up like a bladder,' and after heaving and swelling soft like the waves of the sea, settled, leaving six mountains from seventeen hundred feet down to three hundred feet high. The largest, Jorullo, has thrown up an immense amount of scoriæ and lava. On the same night with its first eruption, two rivers near the spot disappeared, but at six thousand five hundred feet distant, two new ones burst out, leaving their fountains as warm springs. In Iceland also at the same time with this earthquake at Lisbon the Kötlugiâ volcano, one of the most remarkable on the island, covered with ice in its

whole extent, broke out: during its convulsions, the masses of ice, clay and rock it hurled into the sea were so great, that it was filled to the distance of fifteen miles, and where before were fifteen fathoms of water, the tops of these rocks appeared above the surface.

On the night also in which the cities of Lima and Callao were destroyed by an earthquake, four new volcanoes appeared in the Andes. The shocks of earthquakes are always more energetic when distant from any vent for the gas. The inhabitants of the regions near Cotopaxi, Vesuvius and Hecla, dread the effects of earthquakes only, when the volcano ceases to act. In many instances where several volcanoes are grouped together or in a chain there is reason to suppose a connexion between them. The volcanoes of Quito are over a tremendous abyss, of which the various craters are only the vents. The range of volcanoes south of Quito, seem to proceed from one long volcanic chasm. Humboldt considers Lipari, Stromboli and Vulcano, three volcanic islands near Sicily, but different outlets to one submarine volcano; and supposes that as the materials of which each is composed is similar, to the depth of many fathoms, that they have raised themselves as they now are above the level of the sea.

It is very evident that the volcanic exhibitions of the present day are but expiring efforts. The craters which have been formed in modern eruptions, are very small compared with the older ones. Sometimes the more recent craters are entirely embosomed in those of a former date. The number of active volcanoes is gradually diminishing: in many extensive districts, the whole have become extinct. Most of what are called the *overlying* rocks of the globe, are of volcanic origin, but the eruptions of modern times have been insufficient to produce these in such quantities as exist.

DESIGN.

When the inquisitive observer sees and hears of a power of such indefinite continuance, of such prodigious extent and inconceivable energy, possessing sufficient force 'to rend mountains—to raise floods of fiery lava

— to project stones to great heights in the atmosphere — to rock alpine ridges on their foundations — to heave the ocean in unwonted undulations — to shake continents and the solid globe itself,' his mind flies to its omnipotent Creator, and seeks for evidence of a design, which if not positively benevolent, shall to his weak comprehension seem not to be positively destructive. We would not be lead into developing a theory of the earth, but the scientific inquirer, observing the phenonema now in operation of sufficient power to effect such magnificent results, will infer that in primeval ages the same power acting more continually, and with greater intensity, may have been the great agent employed to effect the present disposition of the earth; that all the mountains and valleys have been elevated or submerged by the changes and renovations of volcanic power. All the hard and crystalline rocks of the globe are volcanic, and the great craters which we have mentioned as being so many leagues in extent, have had the office of pouring out from the great laboratory of the earth, all those substances which, existing there as melted lava, or in solution with water, have, after ejection, become hard on the surface and formed the crust of the globe. Such a course as this would effect also all these minor phenonema, of inclined and distorted strata, dikes and veins of different metals and earths.

In the administration of the course of nature, such phenonema, even our short sighted vision can determine as useful and necessary. For we have found a secondary use for all the products of this, our greatest agent in physical changes. Our coal, sulphur, and metals are all the result of igneous agency. Our warm springs, chalybeate wells, and gas streams have all been appropriated by us to some benefit.

It is not either a fanciful speculation of the geologist to suppose that they are a compensative process by which, as the ocean forces her waters into the earth, lavas, sand and mud are thrown up to replenish the land; in the succession of years the lava becomes good soil. The old crater and the sides of Vesuvius become covered in a

few years with groves of chestnut, planted on the richest soil, and in a few centuries the decomposition of the beds of lava throughout the globe, may furnish means for supporting an indefinite number of inhabitants. The coral reefs are founded also on matter thrown up by submarine volcanoes.

If we cannot unravel the design of the author of nature in permitting such a vast central fire, we are able certainly to scan the wise provision of allowing the angry raging elements within, to escape so peacefully from their confinement, and spend themselves by throwing their superfluous matter into the sea, or over a few leagues of territory. Volcanoes are immense safety valves to the globe, chimneys to the subterranean furnace beneath our feet, and are the obvious means of preventing the overthrow of cities and countries by earthquakes. When the inflamed materials, generating in incalculable quantities elastic vapor, are seeking some vent, rolling throughout the great cavity of earth, the orifice of a volcano permits the whole to be discharged without disturbing the superficial strata.

The volcanic system is supposed to be common to the whole universe of planets and suns revolving in the heavens. The celebrated Dr Herschel discovered, beyond any doubt, volcanoes in operation in the moon. The crater of one of the four or five discovered, all luminous with the action of fire, is supposed to be about three miles in diameter.

Volcanoes are conjectured to be alluded to in the sacred volume, in Job, xxii. 15.

> ‘Hast thou observed the ancient tract
> That was trodden by wicked mortals?
> Who were arrested on a sudden,
> Whose foundation is a *molten flood?*
> *　*　*　*　*　*
> Surely their substance was carried away
> And their riches devoured by fire.’

The Prophet Nahum says, ‘The mountains *quake* at him and the hills *melt*, and the earth is *burned* at his presence — his fury is poured out *like fire* and the rocks are *thrown down* by him.’ No phenomena of

nature awake such overwhelming sensations of the power and majesty of Him who formed the universe, who laid the fonndations of the earth, and who is still by his Almighty power, preserving and governing it, as the sight of the smoke, the flames, and the torrents of volcanoes. The awful revelations of his word are brought to our mind, with fearful force, 'Great and marvellous are thy works, Lord God Almighty. Greatly art thou to be feared, God terrible in majesty.'

EXPLOSIONS IN COAL MINES.

We cannot better occupy the remaining pages of this tract, than by giving some account of the dreadful explosions which have sometimes occurred in artificial excavations of the earth. It is known, probably to most of our readers, that coal occurs in strata a yard or two only in thickness, extending laterally however to a great distance. The excavation which forms the mine is made by removing the stratum of coal, leaving however at intervals large pillars to support the roof above. A coal mine thus becomes after a time an intricate combination of cells, and chambers and long passages. At each extremity of the mine there is a perpendicular shaft or well, the air passing down one, and through the mine, and then up the other. This circulation is kept up by means of a fire at the bottom of the ascending shaft.

A great quantity of the air in the mine is exhausted by the constant supply which the fire demands. The vacuum which is thus produced, is filled by air which rushes down through the opposite opening. By this means a tolerably free circulation is produced: still, dreadful explosions often occur by the collection of *inflammable gases* in these subterraneous abodes. There are two kinds of gases which collect in the mines distinguished by the miners under the names of choke-damp and fire-damp. The former consists of carbonic acid, is a heavy kind of air, and is always found in the bottom of mines. It will extinguish a candle, and often destroys life. The Grotto

del Cane furnishes examples of this kind. A dog or any small animal when exposed to the influence of this gas, floating along the bottom of the cavern, becomes senseless and gives no appearance of life, while a man can enter the cave with impunity, the destructive gas being below him. The fire-damp is a light gas floating near the tops of mines above the atmospheric air. This gas coming in contact with flame, a light for example, instantly explodes. This gas prevails very extensively in coal mines; many lives have been lost and much injury done to machinery by its explosions. Miners have often pursued their regular avocations for a considerable length of time with death above and below them: the fire-damp floating over their heads, and the choke-damp encircling their feet.

'When the free circulation of the air in the mines is prevented; when the fire in the furnace-shaft is neglected, or the trap-doors are carelessly left open, accumulations of fire-damp immediately commence in places deprived of the atmospheric current, and soon become very dangerous, unless discovered and attended to by the ventilators. Blasts sometimes take place in some parts of mines, which may not be frequented by the atmospheric air. These generally scorch the persons in their way, though they seldom kill them. When the air has proceeded lazily for several days through a colliery, and an extensive magazine of fire-damp is ignited, then the whole mine is instantly illuminated with the most brilliant lightning — the expanded fluid drives before it a roaring whirlwind of flaming air, which tears up everything in its progress, scorching some of the miners to a cinder, burying others under enormous heaps of ruin, shaken from the roof and thundering to the shafts, wastes its volcanic fury in a discharge of thick clouds of coal-dust, stones, timber, and not unfrequently limbs of men and horses.

'But this first, though apparently the most terrible, is not the most destructive effect of these subterraneous thunderings. All the stoppings and trap-doors of the mines being blown down by the violence of the concus-

sion, and the atmospheric current being for a short time entirely excluded from the working, those that survived the discharge of the fire-damp, are instantly suffocated by the after-damp, the choke-damp, above described, which immediately fills up the vacuum caused by the explosions.'

The following is an account of an explosion of a coal mine which took place in the county of Durham, near Gateshead, taken from the Gallery of Nature and Art.

About half past eleven o'clock on the morning of the 25th of May, 1812, the neighboring villages were alarmed by a tremendous explosion in this colliery. The subterraneous fire broke forth with two heavy discharges from the John pit,* which were almost instantaneously, followed by one from the William pit.† A slight trembling as from an earthquake was felt for about half a mile around the workings; and the noise of the explosion though dull was heard at three or four miles' distance, and much resembled an unsteady fire of infantry. Immense quantities of dust and small coal accompanied these blasts, and rose high into the air, in the form of an inverted cone. The heaviest part of the ejected matter such as pieces of wood, small coal, &c. fell near the pits; but the dust, borne away by a strong west wind, fell in a continued shower from the pit to the distance of a mile and a half. In the village of Heworth it caused a darkness like that of early twilight, and covered the roads so thickly that the footsteps of passengers were strongly imprinted in it.

As soon as the explosion was heard the wives and children of the workmen ran to the working-pit. Wildness and terror were pictured on every countenance. The crowds from all sides soon collected to the number of several hundreds, some crying out for a husband, others for a parent or son, and all deeply affected with an admixture of horror, anxiety and grief.

* This is the name given to the pit through which the miners enter.

† The furnace pit.

The machine being rendered useless by the eruption, the rope of the gin was sent down the pit with all expedition. In the absence of horses, a number of men, whom the wish to be instrumental in rescuing their neighbors from their perilous situation, seemed to supply with strength proportionate to the urgency of the occasion, put their shoulders to the shafts of the gin, and wrought it with astonishing expedition. By twelve o'clock thirty-two persons, all that survived this dreadful calamity, were brought to day-light. The dead bodies of two boys who were miserably scorched and shattered, were also brought up at this time: three boys who escaped alive died within a few hours after the accident. Only twentynine persons were, therefore, left to relate what they observed of the appearances and the effects of this subterraneous thundering. One hundred and twentyone were in the mine when it happened.

They who had their friends restored, hastened with them from the dismal scene, and seemed for a while to suffer as much from the excess of joy as they had lately done from grief; and they who were yet held in doubt concerning the fate of their relations and friends, filled the air with shrieks and howlings, went about wringing their hands, and threw their bodies into the most frantic and extravagant gestures.

The persons who now remained in the mine had all been employed in the workings to which the plane-board was the general avenue, and as none had escaped by that way, the apprehension for their safety began to strengthen every moment. At a quarter after twelve o'clock a number of gentlemen descended the John-Pit in expectation of meeting with some of them alive. As the fire-damp would instantly have ignited from candles, they lighted their way by steel-mills, small machines which give light by turning a plain, thin cylinder of steel against a piece of flint.* Knowing that a great number of the workmen would be at the crane when the explosion hap-

* The sparks thus produced afford sufficient light without doing any injury, as the damp will not take fire unless it come in contact with flame.

pened, they attempted to reach it: but their progress was intercepted at the second pillar by the prevalence of choke-damp. The noxious fluid filled the board,* and the sparks from the steel fell into it like dark drops of blood. Being therefore deprived of life, and nearly poisoned for want of atmospheric air, they retraced their steps to the shaft, and with similar success attempted to go in another direction. They were soon stopped by a thick smoke which stood like a wall before them. Here their flint-mills were rendered useless, and respiration became extremely difficult. There was now no probability of finding any individuals alive; and to the hopelessness of success in this respect, was added their certainty of the mine being on fire, and the probability of a second explosion at every moment occurring, and burying them in its ruins.

At two o'clock several of the gentlemen had come out of the mine; two were in the shaft and two had not yet ascended, when a second explosion much less severe than the first, excited more frightful expressions of grief and terror among the relatives of the persons still in the mine. It had no effect upon the persons in the shaft, except that an unusual heat was perceived by them. The two in the mine hearing its distant growlings, laid themselves down at full length on their faces, and in this posture, by keeping firm hold of a strong, wooden prop placed near the shaft to support the roof of the mine, experienced no other inconvenience from the blast than its lifting up their legs and its poising their bodies in various directions.

As each of the party came up he was surrounded by a group of anxious inquirers. All their reports were equally hopeless; and the second explosion so strongly corroborated their account of the impure state of the mine, that their assertions for the present seemed to be credited. But this impression was only momentary. On recollection they remembered that persons had survived similar accidents, and when the mine was opened been found

* The cavities between the pillars of coal are called boards.

alive. Three men had been shut up during forty days in a pit near Byher, and all that period had subsisted on candles and horse-beans. Persons too were not wanting to infect the minds of the relatives of the sufferers with disbelief in the accounts of the persons who had explored the mine. It was suggested to them, that want of courage or bribery might be inducements to magnify the dangers, and represent the impossibility of reaching the bodies of the unfortunate men. By this species of wicked industry the grief of the neighborhood began to assume an irritable and gloomy aspect. The proposition to exclude the atmospheric air from the mine, in order to extinguish the flame was therefore received with cries of 'Murder,' and with determinations of opposing the proceeding.

On Tuesday, the 26th of May, an immense crowd of colliers assembled round the pits, and were profuse in reproaches on the persons concerned in the mine for want of exertions to recover the men. Every one had some example to relate of successful attempts in cases of this kind, — all were large in their professions of readiness to give assistance; but none were found to enter the inflammable jaws of the mine.

The proprietors of the mine gave the strongest assurances to the crowd that if any project could be formed for the recovery of the men, no expense should be spared in executing it; that every facility should be afforded any person who would enter the mine, but as they were assured by the most eminent viewers in the neighborhood that the mine was in an unapproachable state, they would be accessory to no man's death either by persuasion or bribe.

On Wednesday, the 27th of May, at the clamorous solicitations of the people, two gentlemen again descended the John-Pit in order to ascertain the state of the air. Immediately under the shaft they found a mangled horse in which they supposed they perceived some signs of life; but they had only advanced about six or eight yards before the sparks of the flint were extinguished in choke-damp, and the individual who played the mill began to

show the effects of the carbonic poison by faltering in his steps. His companion therefore laid hold of him and supported him to the shaft. As the baneful poison had now taken possession of the whole of the mine and they found it difficult to breathe, even in the course of the full current of the atmospheric air, they immediately ascended. But the afflicted creatures, still clinging to hope, disbelieved their report. Wishing therefore to give as ample satisfaction as posible to the unhappy women, two other gentlemen descended again and with as little success. The report of these last adventurers partly succeeded in convincing the people that there was no possibility of their friends being found alive. Some indeed went away silent but not satisfied; others with pitiable importunity, besought that measures to recover their friends might evèn yet be adopted and persevered in, and many filled with grief and rage, went about loading the conductors of the mine with execrations, and threatening revenge. There was no unanimity of sentiment among them, and no scheme of proceedings could be invented so fortunate as to meet with the approbation of them all. In the evening of that day, it was therefore resolved to exclude the atmospheric air from entering the workings, in order to extinguish the fire that the explosion had kindled in the mine, of which the smoke ascending the William Pit was a sure indication.

These explosions very often set fire to mines and various methods are employed to extinguish it. Sometimes these pits are filled up so as to exclude the air, or the colliery filled with water. When the fire is not extensive, the mining engineers use portable fire extingguishes. The fire has also been extinguished by the concussion of air produced by the discharges of small cannon, blowing out the flame. The fire was extinguished in this colliery by filling up the pit so as entirely to exclude the air.

Many plans have been proposed and tried to render these terrible calamities less frequent. The proposition was, to invent a lamp, which could be used with safety by the miners in the midst of the inflammable air. The task, hopeless as it seemed to be, was undertaken by sev-

eral gentlemen. Dr Clanny invented the first lamp that could be carried into inflammable air without explosion, but on account of its construction it could seldom be used. This important subject was but little attended to, until the dreadful explosion at Felling Colliery awakened the public mind to the great dangers attending mining, unless some means could be devised for safely introducing light into the mines. The steel mill, though comparatively safe, could not be entirely trusted; in some instances explosions had taken place from it; the expense also was very great, as each miner was obliged to have a miller to give him light.

In the year 1816, Sir Humphry Davy, Mr Stevenson, and Dr Murray brought foward safety lamps, each constructed upon different principles. Sir Humphry Davy's was very simple: it was a common lamp surrounded by a very fine iron wire gauze; thus the air entered to feed the lamp, while the flame could not pass through so fine a covering. Mr Stevenson's was made of a very strong glass cylinder having a metal plate at the top and bottom, perforated with very small holes to permit the air to pass to and from the lamp. That of Dr Murray's was a glass lamp or rather lanthorn, to which good atmospheric air was brought by means of a long leather pipe from the air course. Of these lamps Dr Murray's was applicable but in very few cases. Those of Sir Humphry Davy and Mr Stevenson were both complete safety lamps, but that of the former is decidedly the best and is generally used in Great Britain. Having no glass about it, it is not easily injured, and sufficient light for the miners passes through the wire gauze. To each of these gentlemen the world is highly indebted, and in particular the mining interest of Great Britain.*

* The following account of the Coal Mines at Newcastle, is from Silliman's Travels in England.

Having a few hours to spare, I took a guide, and went out to see as much of Newcastle as I could within the short time which I could command.

The coal mines, for which Newcastle is famous all over the world, naturally attracted my attention first. I went immediately to one of the principal mines, with the intention of descending, but

Putrefied fish which emits a phosphoric light have sometimes been used when candles were deemed dangerous.

finding the adventure would occupy the whole day, I was compelled to relinquish my purpose as my arrangements for leaving Newcastle in the afternoon, had been made. I was therefore obliged to content myself with viewing things on the surface and with interrogating the colliers as to the matters below ground.

The country around Newcastle is full of lofty hills, which present many romantic views; among them the river Tyne winds along and affords the means of conveying the coal to the sea.

The general plan of working the coal mines, is, I believe, the same in all instances. In the first place the hills are bored to ascertain the certain existence of a stratum of coal. Next a pit or shaft is dug, resembling a large well, and the walls of it are constructed of brick or stone. A steam engine with all the machinery necessary to the business, is erected on the surface, and large sums of money are expended in preparations.

One half of the mouth of the mine which I saw, was covered so as to be tight, and a partition extended perpendicularly down the shaft to the bottom or near it. Down that part which is open, men, horses, implements and all things needed below, are conveyed by means of ropes connected with the steam engine, and worked by it. Two baskets alternately rise and fall through the same aperture and convey the coal to the surface.

The other half of the shaft is contrived, so as to convey off the deleterious gases which infest the mines: they are let out through a lateral orifice, terminating in a tall chimney, where a fire is constantly maintained; it is not suffered to go out by day or by night, in summer or in winter. It is obvious that the effect of this fire must be to create a double current; the rarefaction produced by the fire of the chimney, will cause a current of the foul air of the mine upward, while, from the same cause, the fresh air from above will rush down from the open part of the shaft.

There are pipes or tubes to bring the foul air *from*, and to convey the fresh air *to* every part of the mine. This foul air is chiefly an inflammable gas, and as it is constantly pushed up into the fire place, it is there slowly burned, without hazard or inconvenience.

If these precautions, or others of a similar kind, are neglected, the inflammable gas accumulates and mixes with the common air of the mine, and, when the miners descend with lighted candles, the mixture explodes with all the noise and violence of gunpowder, blowing up the mines, and with it men, horses, machinery, and every other moveable thing, forcing them, with fatal velocity, along the narrow chambers, the sides of which, when they do not give way, act like the tube of a gun, to increase the effect. Accidents of this kind have been too frequent. In the year 1708, there was an explosion in a coal mine in this part of England, which killed 69 persons.

The shaft of the mine, which I saw, was about 600 feet deep, and

About eighteen months after the above accident happened, another explosion took place in the same colliery, which killed nine men, thirteen boys and twelve horses, and severely scorched several other persons.

they informed me that the coal lies in strata of 3 or 4 feet in thickness. By a very simple contrivance, the coal is conveyed in wagons half a mile from the mine to the river. The wagon, runs on an iron way, with which the wheels are made to tally, that the carriage may not deviate from its course. A strong rope passing from the wagon is connected with proper machinery, and falls down the shaft of the mine where it is fastened to a great weight. As the road is down the declivityof a hill to the river, it happens, that whenever the wagon with its load of coal, becomes sufficiently heavy, it pulls so hard on the rope that the weight begins to rise and the wagon to descend, which it continues to do till it arrives at the river's brink, where the machine is unloaded, and now, the weight again preponderates, and draws the wagon back with velocity.—Thus time and the labor of horses is saved, and there appears a curious exhibition, a wagon running up and down hill, but *seemingly* without any moving motion.

I looked into the cottages of the miners, and was gratified at seeing every indication of comfort, and a great degree of neatness, which, considering the nature of their employment, was the more remarkable.

SCIENTIFIC TRACTS.

VOL. II......NO. VII.

THE OCEAN.

The ocean presents almost innumerable objects of variety and of interest. Though at first view it seems merely a boundless expanse of water without anything to allure curiosity, a little farther acquaintance with its wonders opens a vast field for scientific research. The elephant upon the land, does not equal in size or strength the huge monsters which roll and gambol in the depths of the ocean. And full as is the wilderness with animated life, it does not in this respect surpass the waters, every drop of which is filled with living beings. The various and ever shifting currents of the atmosphere, are perhaps not more numerous or more inexplicable, than the currents of the ocean. The exhalations of the ocean moisten the air, and fertilize the ground, replenish the springs, and supply the ceaseless flow of the rivers.

The waters of the ocean cover about two thirds of the earth's surface. They everywhere have the same level except when agitated by winds or some other local causes. Geographers have assigned different names to different parts of this great body of water, such as the Pacific, the Atlantic, the Frozen, the Southern and the Indian ocean. It is unnecessary, however, in the prosecution of the present object to notice those divisions.

1. SALTNESS OF THE OCEAN.

When a person stands for the first time upon the shore, and looks over the wide rolling wave, he is lost in

wonder at the sublimity of the scene. His next movement is to taste of the water. He finds it to be salt and brackish. By chemical decomposition its component parts are found to be, Lime 2·9 gr. Magnesia 14·8, Soda 96·3, Sulphuric Acid 14·4, Muriatic Acid 97·7. The waters of the ocean are generally composed of these ingredients at all times and in all places, but not always in the same proportions. By boiling sea-water common salt is precipitated. The boilers of steamboats have sometimes been nearly filled by a solid incrustation of salt deposited upon their sides. Immense quantities of salt are manufactured every year, by evaporation of sea-water in the open air. In this way natural beds of salt of immense extent and depth have been formed. In the colder latitudes; the saltness of the sea is, in general, less than between the tropics. There are however exceptions, and it has been observed that those large gulfs into which many rivers empty are less salt than other parts of the ocean.

Bergmann, a celebrated Swiss naturalist, has with great care made the following observations.

Near Iceland the sea contains of salt		$\frac{1}{12}$ to	$\frac{1}{40}$ of its weight.
Near the coast of - - -		$\frac{1}{10}$	$\frac{1}{7}$
In the Categat - - - -			$\frac{1}{10}$
In the Baltic sea - - -			$\frac{1}{30}$
In the Irish sea - - -			$\frac{1}{40}$
In the English channel - -			$\frac{1}{30}$
In the Atlantic	Coast of France		$\frac{1}{32}$
	Coast of Spain		$\frac{1}{46}$
The Mediterranean	Near Castiglione		$\frac{1}{24}$
	Near Malta		$\frac{1}{27}$

From these observations it appears that there is a very considerable difference in the saltness of the sea, even where the waves are continually meeting and mingling. As a general rule, however, in going from the equator to the poles, the saltness of the sea diminishes. It has also in many places been found that the water on the surface of the ocean is less salt than on the bottom.

Some of these variations are easily accounted for; others at present are entirely unknown. It is perfectly natural that a bay, into which many large rivers are constantly pouring a supply of fresh water, should not be so salt as other parts of the ocean. But why there should be difference between the tropical and arctic seas, or between the surface and the depths of the ocean in this respect, no satisfactory reason has as yet been assigned.

Neither is it easy to discover the origin of the saltness of the sea. The beneficent design of our Creator is manifest in this arrangement, as without this saltness and the continued agitation produced by winds, tides and currents, the waters would become tainted, and the ocean would prove the boundless reservoir of contagion and death. But whence comes this saltness? Some have supposed it proceeds from immense beds of salt, in the bottom of the ocean. Such beds have indeed been found, but they appear to be rather deposits of salt, which the ocean has formed by precipitation. Instead of being the cause, they are the effect of the ocean's saltness. The corruption of river water has been absurdly assigned as the cause. By this theory the ocean is represented as a vast lake, filled by the ceaseless flow of rivers of fresh water, which by corruption has become salt and brackish. This theory originated from the fact that the fresh water which is discharged into close lakes, by some process of decomposition deposits salt. It is however said, that if this were the cause of the saltness of the ocean, it would be continually growing more salt; and there is no evidence that this is the fact. This opinion was first advanced by Halley, a celebrated English philosopher, and he inclined to the opinion that there was a progressive increase, though necessarily very slow. 'Several modern philosophers,' says Malte Brun, 'consider the sea as the residuum of a primitive fluid, which must have held in solution all the substances of which the globe is composed, that these sea waters having deposited all the earthy principles both acid and metallic with which they were impregnated there remains in their residuum (which is the present

sea) some of these elementary principles too intimately combined with water to escape from it; and with respect to the *bitterness* of sea waters, as it diminishes in proportion to the depth, it can arise solely from the great quantity of decomposed and putrifying animals and vegetable substances which float in the ocean, and which the running waters never cease to bring into it.' This is a kind of philosophising in which we can place but little confidence for its basis is supposition not fact. Men are generally unwilling to acknowledge ignorance, and the pride of human reason is more gratified with any theory, if it have but the air of philosophy, than with none at all.

DEPTH OF THE OCEAN.

The bottom of the ocean is like the surface of the dry land. Islands are but the summits of mountains rising above the waves. If a person were wafted along in a balloon just above the region of the clouds, the Alps and the Andes would be the islands of his vapory sea. In some places from his airy flight he would in vain drop the sounding line, and again when passing over some high land, with the lead and line, he would find soundings. Thus it is with the navigator of the ocean. He sails over lofty mountains and deep valleys, and mighty monsters gambol in these valleys, and roam in the fastnessess of these submarine mountains. Sometimes the lofty summit of some table mountain presents a shoal upon which the navigator anchors his ship. Again the precipitous summit of some granite clift, pierces through the surface of the ocean, and when the ship is dashed by the storm against this rock, the drowned mariner rolls down the declivity of the mountain till he finds a grave far below, in the depths of the valley at its base. Again, the summit of the ocean mountain rises above the wave, and becomes the fertile island, thronged with inhabitants and all the variety of animated life. In most parts of the open ocean, it is so deep, that no bottom has been found by any line yet used. In consequence of the great depth of the ocean, it has frequently been called bottomless, and by the ignorant it has been

supposed to be literally without a bottom. The mountains of the dry land do not rise above 20,000 feet and reasoning from analogy, it is exceedingly improbable, that the depth of the ocean, in any part, can exceed 30,000 feet. But it would hardly be in our power to find the bottom even at one third of that depth. Lord Mulgrave, who had distinguished himself upon the floor of parliament, as well as upon the deck of his ship, threw a sounding line in the Northern ocean, of greater length than had ever before been used. He heaved a very heavy sounding lead, gave out along with it a rope of 4,680 feet. But he found no bottom. This is the greatest depth that has ever been tried to be measured, and it is very possible that if the rope had been four times as long, the attempt would have been equally unavailing.

ON SWEETENING SEA WATER.

There has been more suffering for want of water upon the ocean, than on any other part of the globe. Often does the seaman die a dreadful death from thirst in the middle of the ocean. Large rewards have been offered for the discovery of the best mode of obtaining fresh or sweet water from the salt water. At first it was supposed that simple distillation would do it, but upon experiment it was found, that though by this process the water was deprived of its saltness, the bitter taste still remained. It was then found that by mixing salt of tartar with sea water and distilling both, fresh and nearly pure water could be obtained. Little advantage however was derived from this discovery, as the expense was so great as to preclude its general use. Distillation has however been occasionally resorted to in an emergency and by this means many lives have been saved. The distilled water by being exposed some time to the air loses much of its disagreeable flavor. A handful of ashes or a little soap thrown into the water previous to distillation has been found useful in rendering the water obtained by this process, more palatable.

Capt. Chapman was sailing off the north cape of Finland, and by accident lost nearly all of his water. While thus circumstanced a gale of wind arose, which blew hard for three weeks and drove them far off to sea. The captain was in great anxiety. The water they had would last but a short time, and he had no still on board. But necessity, the mother of invention, aided him in contriving one. By means of an old pitch pot, with a wooden cover, and a pipe made of a pewter plate, and a cask for a receiver, he commenced operations. He put seven quarts of sea water and an ounce of soap into the pot and placed it on the fire. As soon as the pot boiled the condensed vapor began to flow through the pipe into the receiver. In 28 minutes he had obtained a quart of fresh water. This water though not very palatable answered for all necessary purposes. They constantly kept their still at work and got a gallon of water every two hours. And thus the crew were saved from great suffering, if not from actual death.

There is however no water equal to that produced by nature's distillation. The clear stream which comes bubbling from the spring, cannot be imitated by the chemist. The still is only used in emergencies. Every sea captain prefers to fill his casks on the shore.

CURRENTS.

The currents of the ocean are almost as numerous and various as the ever shifting breezes of the air. Some of these are undoubtedly caused by particular winds. But others cannot be ascribed to this cause, neither is it easy to ascertain their origin. These currents are found flowing in all directions, east, west, north, and south, being formed by various and often unknown causes. Sometimes the waters on the surface of the ocean, are flowing in one direction, while beneath these is a current of equal rapidity and strength flowing exactly contrary. In navigation the business of currents requires special attention, for a ship often unknowingly gets into one of them, and is borne far from her true course, and is sometimes carried backward by its force

when apparently rapidly approaching the wished for port. Much attention has therefore been devoted to this subject, and the direction of currents and their rapidity have been carefully marked.

These currents are generally found most violent under the equator. Indeed all the motions of the ocean are here more observable than in any other part. There is a very strong current running along the coast of Africa. A strong wind is required to stem it. If a ship bound to the coast of Guinea happens to overshoot the mouth of any river which it desires to enter, it is borne so strongly away by the current, that it is compelled to put out to sea again to correct the error. This current however does not extend more than thirty miles from the coast.

A strong current has been found by the explorers of the Northern ocean setting from the pole towards the equator. Captain Parry, when travelling for many days upon a floating continent of ice, was carried by the current nearly as rapidly to the south, as he could journey towards the pole, and from this cause he was compelled to return unsuccessful from his expedition. These currents have drifted upon the coast of Iceland such enormous quantities of ice that all the northern gulfs of that country are filled with it to the very bottom, though they are often 500 feet in depth. The ice is sometimes by the force of the current piled up into immense mountains. Some years no ice, but immense forests of pine and fir are cast along the shore, exciting the astonishment of all.

It is impossible to recount the number of currents which are found, for they are as numerous as the shifting winds and a variety of causes are continually forming new ones, and obliterating those which have long continued.

The most celebrated current is that well known by the name of the Gulf Stream. The waters of the Atlantic ocean, probably drawn by the trade winds, flow violently into the gulf of Mexico and discharging themselves through the channel of Bahama, set in a constant

and rapid stream along the coast of North America, to the northward and eastward. This current continually widens and grows weaker as it extends outward into the Atlantic. According to some navigators its influence is to be felt as far as the coasts of Scotland and Norway. Bottles which have been cast into the ocean in the gulf of Mexico have afterwards been found on the coast of England and Ireland. Far out into the ocean the water of the Gulf Stream is several degrees warmer, than the waters of the Atlantic, through which it is flowing. At about 32° north latitude, and 55° west longitude, the Gulf stream is 20 leagues in breadth.

In many places there are opposite currents passing along side by side. In the Categat a northern current flows from the Baltic along the coasts of Sweden, and a southern current proceeds into the Baltic along the coast of Jutland. In the North sea, there is a northern and a southern current flowing rapidly past each other.

The Mediterranean sea has long attracted attention from the remarkable nature of its currents. Through the straits of Gibraltar, a strong current is continually pouring the waters of the Atlantic into this inland sea. At its other extremity, from the Euxine through the Archipelago, a strong current is ceaselessly pouring its floods into the Mediterranean. It is also receiving immense contributions from the numerous rivers which empty into it, such as the Nile, the Rhone and the Po. This has ever been one of the most extraordinary appearances in nature. This sea is continually receiving these immense accessions, and yet there is no visible outlet. It is seen to return none of these waters. All of its rivers bring fresh supplies. All of its straits are continually pouring their waters into it. It has therefore justly excited the wonder of mankind in every age. How are these vast accessions disposed of. This basin is continually receiving — apparently never returning, and yet no fuller now, than it was centuries ago. Some have supposed that there must be subterraneous passages, communicating these waters with those of the Red sea ; and a story is told of a fish, caught in the Mediter-

ranean, and marked with a ring, which soon afterwards was found in the Red sea. This however is fable. It is conjecture without proof. The mouth of the straits of Gibraltar, between cape Spartel, and cape Trafalgar, is near seven leagues wide. Through this there is a strong current setting, and it is now pretty certainly ascertained that there is an under current, by which as great a quantity of water is carried out as comes flowing in. The fact of there frequently being two currents, an upper and an under current, is now clearly established. Some gentlemen on board a frigate, went with their pinnace into the mid stream, and were rapidly borne along by the current. They then, with a large cannon ball, sunk a bucket. When they had lowered it down to a certain depth it checked the boat's motion, and by letting it down still farther, the boat was driven ahead, against the upper current. The upper current was about 4 or 5 fathoms deep, and the lower the bucket was let fall the swifter the under current was found. This under current through the straits of Gibraltar undoubtedly affords an outlet for the vast quantities of water which are continually flowing into the Mediterranean sea.

Sometimes two strong currents meet in such a way, that a whirlpool is formed. These formerly inspired navigators with unspeakable terror. Many of them, which were celebrated in most extravagant strains, in ancient poetry, are now, in consequence of the superior knowledge in the art of navigation, deemed perfectly harmless. There is one, however, on the coast of Norway, which still holds out terror to the seaman. The famous Maelstroom is indeed a dreadful and voracious vortex. 'The name it has received from the natives signifies the *navel of the sea;* since they suppose that a great share of the water of the sea is sucked up and discharged by its vortex. A minute description of the internal parts, is not to be expected, since none who were there ever returned to bring back information. The body of the waters that form this whirlpool, are extended in a circle above thirteen miles in circumfer-

ence. In the midst of this stands a rock, against which the tide in its ebb is dashed with inconceivable fury. At this time it instantly swallows up all things that come within the sphere of its violence, trees, timber and shipping. No skill in the mariner, nor strength of rowing can effect an escape; the sailor at the helm finds the ship at first go in a current opposite to his intentions; his vessel's motion, though slow in the beginning, becomes every moment more rapid; it goes round in circles still narrower and narrower; till at last it is dashed against the rocks and instantly disappears; nor is it seen again for six hours, till the tide flowing it is vomited forth, with the same violence with which it was drawn in. The noise of this dreadful vortex still farther contributes to increase its terror, which with the dashing of the waters and the dreadful valley, if it may be so called, caused by their circulation, makes one of the most tremendous objects in nature.'

TIDES.

The periodical ebbing and flowing of the waters of the ocean is ascribed primarily to the influence of the moon, which tides are in some degree increased or diminished by the action of the sun.

The dependence of tides on the moon was first explained by Newton, and has been illustrated and confirmed by the labors of later mathematicians. The general principle of attraction, which binds the myriads of revolving worlds together, and curbs their rapidity and guides them in their courses, affects not merely the united mass of any particular world but also the particles of which that mass is composed. When the moon is in the meridian, the water of that place being immediately under the moon is nearer it than any other part of the globe is; consequently it is attracted more powerfully than any other part of the globe. The waters will therefore be attracted by the moon, and rise in a heap. As the moon moves along in its path, this high wave, created by her influence, will follow. Thus it is that the waters of the sea move from all parts, to the point over which the

moon is. Obstructions from the land and the opening of bays and inlets, operate in various,ways in modifying the regularity, rapidity and extent of tides.

This however accounts for but one tide in the 24 hours when in fact there are two. While it is high tide in that hemisphere, over which the moon is placed, and thus is operating by its immediate attraction, it is also high tide in the opposite hemisphere, at the point, farthest distant from the moon. This second tide does not admit of so simple an explanation, and we shall not here attempt to elucidate it, but only allude to the fact.

If the ocean covered the whole earth and were everywhere equally deep, the water would, uniformly, follow the influence of the sun and moon and great regularity in the height of the tides would be the consequence. The great diversity in the height of the tides, which really exists, is owing to the unequal depth of the actual bed of the ocean, the situation of continents and islands, the various breadths and depths of channels between different seas, the direction of winds, &c.

Lakes and seas have very small tides, because the moon attracting all parts alike or because the strait connecting the sea with the ocean, is too narrow too allow great quantities of water to pass and repass before the influence of the moon ceases. In some parts of the Mediterranean, the tides are scarcely perceptible; in the eastern part, at Naples, they sometimes rise a foot, at Venice two feet.

Whenever tides meet with any direct obstacle, the waters often rise far above the ordinary level of the sea, especially if a considerable momentum had been previously acquired by their passage onward. The Severn sea in England extends far into the land, and is very narrow at the extremity; the tide there rises to the height of 30 feet. The bay of Fundy is hemmed in by a high rocky shore and as tides come in from its broad sweep over the Atlantic, it rises sometimes to the height of one hundred feet and so rapidly, that animals feeding on the shore, have not time to make their escape.

The momentum acquired by the tides admits of familiar illustration. All who have stood on the sea shore and

watched the approaching wave have observed its apparent sudden increase of power, as it rippled up upon the sand beach or dashed against the rocks — its strength was not perceived until resistance was presented. Tides also, frequently rise to a great height at the mouths of wide rivers, which open in the direction of the stream of the tide.

The influence of the tides is felt in the Amazon to the distance of one hundred miles from where it empties into the ocean, the progressive motion of the water no more impeding the progress of a wave against a stream than the velocity of the wind prevents sound from being carried in a direction opposite to it.

PHOSPHORESCENCE OF THE SEA.

The luminous appearance which the waters of the ocean at times assume, is a magnificent and surprising spectacle. The ship driven impetuously through the billows, seems to throw out furrows of fire, and leaves behind her a brilliant and fiery wake. There is almost an endless variety of beauty in those appearances. When a calm glasses the surface of the ocean, the dipping of an oar or any other agitation of the water, causes a thousand spangles to glitter upon the surface. But nothing can exceed the grandeur of the scene, when the tumultuous waves are breaking and dashing in fiery foam. The light afforded by this luminous phenomenon is so great that at times persons have been able to read by it. Not only is this light to be seen in the bows and wake of a ship, but fishes leave a luminous track behind them when swimming near the surface, so that not only their size but form is discernible. Accounts of the phosphorescence of the sea may be found in the journal of almost every voyager. The following description is taken from Stewart's journal of a Residence in the Sandwich Islands. 'The exhibitions of the day, have been followed at night by a phosphoretic scene of unrivalled splendor and sublimity. We had often before observed luminous points, like sparks of fire, floating here and there in the furrow

of our vessel; but now the whole ocean was literally bespangled with them. Notwithstanding the smoothness of the surface there is a considerable swell of the sea; and sparkling as it did on every part as with fire, the mighty heavings of its bosom were indescribably magnificent. It seemed as if the sky had fallen to a level with the ship, and all its stars, in tenfold numbers and brilliancy, were rolling about with the undulations of the billows.

'The horizon in every direction, presented a line of uninterrupted light, while the wide space intervening was one extent of apparent fire. The sides of our vessel appeared kindling to a blaze, and, as her bows occasionally dashed against a wave, the flash of the concussion gleamed half way up the rigging, and illuminated every object along the whole length of the ship. By throwing any article over-board, a display of light and colors took place, surpassing in brilliancy and beauty the finest exhibition of fire-works. A charming effect was produced by a line coiled to some length, and then cast into the water at a distance; and also by a bucket of water dashed from the side of a vessel. The rudder too, by its motions, created splendid coruscations at the stern, and a flood of light, by which our track was marked far behind us. The smaller fish were distinctly traceable, by running lines, showing their rapid course; while now and then, broad gleamings, extending many yards in every direction, made known the movements of some monster of the deep. But minuteness will only weary without conveying any adequate impression of the scene: it would have been wise, perhaps, only to have said that it was among the most sublime, nature herself ever presents.

'The cause of this phenomenon was long a subject of speculation among men of science, but is now satisfactorily ascertained to be sea-animalcula of the luminous tribe, particularly the species *Medusa*. The *Medusa pellucens* of Sir Joseph Banks, and the *Medusa scintillans* of Mr Macartney, emit the most splendid light. The degree and brilliancy of the exhibition are supposed to depend on the state of the atmosphere and sea. A more

grand display than that which we have witnessed, probably seldom if ever takes place.'

This phenomenon has been ascribed to various causes; but the explanation presented by Mr Stuart is the one now most generally admitted. The little animal by which this light is produced, is sometimes called *the glow worm of the sea.* This animal is exceedingly small, thin and transparent, and like the fire-fly, with which we are all acquainted, emits a brilliant light. The sea contains many animals of this nature, of different species. The *Medusas* have little antennæ or horns, from which they dart a strong light while the rest of their body remains in obscurity. All the zoophytes appear to be in a greater or less degree phosphorescent. Some accurate observers have also thought, that in addition to this *glow worm* light, there is a luminous appearance originating from the decomposition of vegetable and animal substances, similar to the phosphorescence of *light wood.* It is by no means improbable that there is the combination of various causes in gilding the ocean with such fiery splendor.

PECULIARITIES OF THE ARCTIC SEAS.

It is to be expected that the ocean extending from the equator to the poles, should exhibit peculiarities corresponding to these extremes of the earth. The aspect of the ocean amid the snow and ice of the arctic circle, is so different from its appearance between the tropics, that it deserves a particular description. The following vivid sketch of scenes observed within the arctic circle, will be read with interest.

'After the continued action of the sun has at last melted away the great body of ice, a short and dubious interval of warmth occurs. In the space of a few weeks, only visited by slanting and enfeebled rays, frost again resumes his tremendous sway. It begins to snow as early as August, and falls to the depth of two or three feet before October. Along the shores and bays, the fresh water, poured from rivulets or drained from the thawing of former collections of snow, becomes quickly converted into solid ice. As the cold augments, the air

deposits its moisture, in the form of a fog which freezes into a fine gossamer netting, or slender icicles, dispersed through the atmosphere, and extremely minute, that might seem to pierce and excoriate the skin. The hoar-frost settles profusely, in fantastic clusters on every prominence. The whole surface of the sea steams like a lime-kiln; an appearance, called the *frost-smoke*, caused, as in other instances of the production of vapors, by the waters being still relatively warmer than the incumbent air. At length the dispersion of the mist, and the consequent clearness of the atmosphere, announce that the upper stratum of the sea itself has become cooled to the same standard; a sheet of ice spreads quickly over the smooth expanse, and often gains the thickness of an inch in a single night. The darkness of a prolonged winter now broods impenetrably over the frozen continent, unless the moon chance at times to obtrude her faint rays, which only discover the horrors and wide desolation of the scene.' The wretched settlers, covered with a load of bear-skins, remain crowded and immured in their huts, every chink of which they carefully stop against the piercing external cold, and cowering about the stove or the lamp, they seek to doze away the tedious night. Their slender stock of provisions, though kept in the same apartment, is often frozen so hard as to require to be cut with a hatchet. The whole of the inside of their hut becomes lined with a thick crust of ice; and if they happen for an instant to open a window, the moisture of the confined air is immediately precipitated in the form of a shower of snow. As the frost continues to penetrate deeper, the rocks are heard at a distance to split with loud explosions. The sleep of death seems to wrap up the scene in utter and oblivious ruin. At length the sun reappears above the horizon; but his languid beams rather betray the wide waste than brighten the prospect. By degrees however the further progress of the frost is checked. In the month of May the famished inmates venture to leave their huts in quest of fish on the margin of the sea. As the sun acquires elevation, his power is greatly increased. The snow grad-

ually wastes away — the ice dissolves apace — and vast fragments of it detached from the cliffs, and undermined beneath, precipitate themselves on the shores with the noise and crash of thunder. The ocean is now unbound and its icy dome broken up with tremendous rupture. The enormous fields of ice thus set afloat, are, by the violence of winds and currents again dissevered and dispersed. Sometimes impelled in opposite directions, they approach, and strike with a mutual shock like the crush of worlds — sufficient, if opposed, to reduce to atoms, in a moment, the proudest monuments of human power. It is impossible to picture a situation more awful than that of the poor crew of a whaler, who see their frail bark thus fatally inclosed, expecting immediate and fatal destruction. Before the end of June the shoals of ice in the Arctic seas are commonly divided, scattered and dissipated. But the atmosphere is then almost continually damp, and loaded with vapor. At this season of the year a dense fog generally covers the surface of the sea, of a milder temperature indeed than the frost smoke, yet produced by the inversion of the same cause. The lower stratum of air, as it successively touches the colder body of water, becomes chilled, and thence disposed to deposit its moisture. Such thick fogs, with mere gleams of clear weather, infesting the northern seas during the greater part of the summer, render their navigation extremely dangerous. In the course of the month of July the superficial water is at last brought to an equilibrium of temperature with the air, and the sun now shines out with a bright and dazzling radiance.'

There is no region of our globe more full of appalling scenes, and exciting dangers. The descriptions given by those who have ventured among the bleak tempests of these northern seas, almost cause the blood to chill in our veins. Many a ship has been surrounded by vast islands of ice, and the wretched seamen have there found their graves. Who can read without agitation the following graphic sketch.

'The fields of ice are frequently of immense extent. Cook found a chain of them which joined Eastern Asia

to North America. The appearance of these continents and islands of ice surpass all that the imagination can conceive. Here we fancy that we behold mountains of pure crystal and valleys sown with diamonds. There, grayish towers with their resplendent points seem to rise above a rampart crowned with ice. The magnifying medium of a hazy atmosphere renders this spectacle still more gigantic. He must have a heart of iron who dare penetrate into these inhospitable seas; for if the navigator has not to fear tempests, which are extremely rare in these latitudes, nor waterspouts and hurricanes, which are there unknown, he will be assailed by other dangers much more capable of appalling the most intrepid minds. Sometimes huge bodies of ice, impelled along by the winds and the currents of the sea, dash against his frail vessel; and there is no rock so dangerous or so difficult to avoid. Sometimes these floating mountains treacherously surround the navigator, and block up every outlet; his ship is arrested in her course, and becomes immovable. In vain does the feeble axe endeavor to break these enormous masses, in vain do the sails invite the winds; the ship as it were, soldered into the ice, and the mariner, cut off from the world of living beings, remains fixed in a solitude of death. How frightful is the situation of those who, thus hemmed in by the ice, have no other resource left than to quit their vessel and walk over that consolidated crust of sea, which is every moment cracking and ready to sink under their feet! When almost dead with cold and hunger, they consider themselves fortunate should the floating piece of ice on which they sail, cast them upon the shore of Siberia, or Nova Zembla. But there is generally very little hope of life for the wretched beings who suffer shipwreck in these dreadful regions. Either the icy waves engulf them, or they are devoured by the tyrant of this dreadful empire, the white bear; or, lastly, the intensity of the cold extinguishes the vital heat, their feet adhere to the ice, their blood no longer circulates in their veins, and the polar night becomes to them a night which is eternal.'

A terrific account has been given of a ship once found floating in this ocean surrounded with fields and mountains of ice, and every individual of the ship's company frozen. The intensity of the cold had preserved every body from corruption. It seems that the ship had been caught in the ice, and detained in defiance of every effort to liberate her. All their fuel was soon consumed. Their fire expired. Every soul was stiffened in death. One gentleman was found with his pen in his hand writing to his absent wife.

The origin of the immense ice mountains which northern navigators so frequently meet, is difficult to be ascertained. The ice which obstructs the navigation of the arctic seas, is of two different kinds. One kind is formed by the congelation of salt water. It is fibrous and very porous, and not at all transparent. Sometimes, as far as the eye can reach, a compact unbroken field extends. Again, the whole ocean seems filled with floating fragments closely jammed together. Again those fragments are so separated that a ship may work its way along between them. And still again these fragments dashed together by the winds, are ground up to minuter fragments, called *mash ice.*

But the ice mountains or *icebergs* as they are usually called, are evidently of different origin; they are formed by the congelation of fresh water and not salt. From them ships supply their casks with the purest and softest water. These mountains rise to an immense height, sometimes towering far above the masts of the largest ships. No explanation of the origin of these has appeared more satisfactory, than the one I now quote from a writer in the Edinburgh Review.

'In those inhospitable tracts, the snow which annually falls on the islands or continents, being again dissolved by the progress of the summer's heat, pours forth numerous rills and limpid streams, which collect along the indented shores, and in the deep bays inclosed by precipitous rocks. There this clear and gelid water soon freezes, and every successive year supplies an additional investing crust, till, after the lapse perhaps of

several centuries, the icy mass rises at last to the size and aspect of a mountain, commensurate with the elevation of the adjoining cliffs. The melting of the snow, which is afterwards deposited on such enormous blocks, likewise contributes to their growth; and by filling up accidental holes or crevices, it renders the whole structure compact and uniform. Meanwhile, the principle of destruction has already begun its operations. The ceaseless agitation of the sea gradually wears and undermines the base of the icy mountain, till at length by the action of its own accumulated weight, when it has perhaps attained the altitude of a thousand or two thousand feet, it is torn from its frozen chains and precipitated with tremendous plunge, into the abyss below. The mighty launch now floats like a lofty island on the ocean; till driven southwards by the winds and currents, it insensibly wastes and dissolves away in the wide Atlantic.

'Such we conceive to be the real origin of the icy-mountains or *icebergs*, entirely similar in their formation to the *glaciers* which occur on the flanks of the Alps and Pyrenees. They consist of a clear, compact and solid ice, which has the fine green tint verging to blue, which ice or water, when very pure, and of sufficient depth, always assumes. From the cavities of these icebergs, the crews of the northern whalers are accustomed, by means of a *hose* or flexible tube of canvas to fill their casks easily with the purest and softest water. Of the same species of ice, the fragments which are picked up as they float on the surface of the ocean, yield the adventurous navigator the most refreshing beverage.

'It was long disputed among the learned, whether the waters of the ocean are capable of being congealed; and many frivolous and absurd arguments of course, were advanced to prove the impossibility of the fact. But the question is now completely resolved and the freezing of sea-water is established both by observation and experiment. The product, however, is an imperfect sort of ice, easily distinguishable from the result of a regular crystallization; it is porous, incompact, and imperfectly diaphanous. It consists of spicular shoots, or thin flakes, which

detain within their interstices the stronger brine; and its granular spongy texture has, in fact, the appearance of congealed syrup, or what the confectioners call *water-ice*. The saline ice can, therefore, never yield pure water, yet, if the strong brine, imprisoned in it, be first suffered to drain off slowly, the loose mass that remains will melt into a brackish liquid, which, in some cases may be deemed potable.' The latter part of this description, though not referring particularly to ice mountains, contains interesting intelligence respecting ocean ice. The quantity of ice occasionally met even by navigators in the middle of the temperate zone is truly amazing. Not unfrequent do the regular packets from Liverpool to the U. S. fall in with these huge floating islands. And vessels in the night have dashed to pieces, by driving against them. Harbors in the northern parts of America are frequently filled with ice driven from the northern ocean, and forced in by the wind. The storms of the Arctic sea piles cake upon cake, forcing the ice at times to rise to an enormous height, and decking the bleak scene with most fantastic forms of beauty, and terrific scenes of grandeur, says an eye-witness.

The mountains of hard and perfect ice, it has been shown, are the gradual production of perhaps many centuries. Along the western coast of Greenland, prolonged into Davis's Strait, they form an immense rampart, which presents to the mariner a sublime spectacle, resembling at a distance whole groups of churches, mantling castles, or fleets under full sail. Every year, but especially in hot seasons, they are partially detached from their seats and whelmed into the deep sea. In Davis's Strait these icebergs appear most frequent; and about Leisco bay, where the sounding exceed 300 fathoms, masses of such enormous dimensions are met with, that the Dutch seamen compare them to cities, and often bestow on them the familiar names of Amsterdam or Haarlem. They are carried towards the Atlantic by the current, which generally flows from the northeast; and after they reach the warmer water of the lower latitudes they rapidly dissolve, and finally disappear, probably in the space of a few months.'

THE EFFECTS OF WINDS.

The ocean, which at times rages with inconceivable fury, lashed by the tempests, is at other times as calm and placid as the most peaceful lake. The voyager who is one day driven by a most furious hurricane, perhaps the next day lies calm and motionless upon the unrippled bosom of the Atlantic. When the ocean is thus smooth, a breeze is seen approaching some time before its arrival. Captain Basil Hall gives a description of the first appearance of an approaching breeze, which is exceedingly vivid and interesting. 'In the course of the afternoon, we perceived from the mast-head, far astern, a dark line along the horizon, which some of our most experienced hands pronounced the first trace of a breeze coming up. In the course of half an hour, this line had widened so much that it could easily be perceived from the deck. Upon seeing this the whistlers redoubled their efforts; and whether, as they pretended, it was owing to their interest with the clerk of the weather office, or whether the wind, if left alone, would have come just as soon, I do not venture to pronounce; but certain it is, that, long before sunset, our hearts were rejoiced by the sight of those numerous flying patches of wind, scattered over the calm surface of the sea, and called by seamen catspaws — I presume from the stealthy, timorous manner in which they seem to touch the water and straightway vanish again. By and by, the true wind, the ripple from which had marked the horizon astern of us and broken the face of the mirror shining brightly everywhere else, indicated its approach, by fanning out the sky-sails and other flying-kites, generally supposed to be superfluous, but which upon such occasions as this, do good service, by catching the first breath of air, that seems always to float above the water. One by one the sails were filled, and as the ship gathered way, every person marked the glistening eye of the helmsman, when he felt the spokes of the wheel pressing against his hand, by the action of the water upon the rudder.'

But when the breeze swells to a gale, and the surface of the ocean is rolling in mountain billows, a scene is presented surpassed by none other which our globe exhibits. No description can convey an adequate idea, of the real sublimity of the prospect presented from the deck of a ship in such an hour. An eloquent descriptive writer, thus attempts to delineate a storm at sea.

'After taking reef on reef, and furling sail after sail during the night, it became necessary this morning from the violence of the storm, to heave the ship to, and let her drift with the wind. The scene is new and terrific. The dead lights are in; and besides the gloom thus thrown over all below, the cabin has been made still more comfortless, by a heavy sea which broke over the ship, and poured a torrent of water down the companion-way. Everything not strongly lashed is driving from one side to the other, while we ourselves, some seated on the floor, some on trunks and boxes, and others braced in our berths, are obliged to cling to whatever is within reach to prevent being dashed about in the same manner. The wind howls dismally through the spars and rigging, and every wave that rushes along the sides of the vessel, or breaks above the bulwarks and thunders over our heads, seems to threaten destruction.

'At nine o'clock I went on deck: I had anticipated a scene of grandeur, but its sublimity and fearfulness far surpassed my expectation. No description can convey a just impression of it to your mind. Imagine for a moment the mountains of Otsego to be rolling in every direction with high and broken swells, over the lake and valley. Just so monstrous are the billows that rage around us. We are in the Gulf-stream and the current and storm being in opposite directions, the waves are not only high and heavy, but irregular in their course, and so rapid in their succession, that before the ship, in her descent, is half way down the abyss between them, the next sea often collects to a tremendous height above her bowspirit, over which it appears impossible for her to rise. Still she as often mounts its threatening waters, and rides in triumph on its summit.

But the labor is excessive, and as she plunges from the top of one wave to the gulf below, and after a momentary pause rushes again to the height of another, every timber groans in the effort, and at times she trembles to her keel, as if foundering in the struggle.

'I was above when she made the most fearful plunge we have yet felt. Several of the crew were at the time securing the flying jibboom and with the bowsprit and whole head of the ship were instantly buried in a mountain of water. An involuntary shriek as their hats were seen sweeping top-mast high on the passing wave expressed the fear that they too were hurried to destruction. But happily they maintained their hold, and though bruised and breathless escaped a watery grave.'

Sometimes a sudden gale comes with very little warning, and with almost inconceivable fury, in a short time throws the ocean into uproar. In an instant, a ship may be thus overturned and sunk to the bottom of the ocean, leaving no one to tell the tale.

'At twelve o'clock last night a gale commenced, and in an hour's time, we were compelled to lay to under a storm-stay-sail only. The howling of the tempest, the plunging of the vessel, and trampling and hallooing of the sailors, effectually prevented our taking any rest. The first person from the deck this morning, reported the wind to be a hurricane and the waves mountain high ; the latter circumstance we were ready to believe without ocular demonstration. One or two only of the passengers attempted to take breakfast. While at the table a sea struck the ship along her whole length, from the quarter deck to the bows, and threw her nearly on her beam-ends. She lay trembling under the stroke till I thought she would never rise again ; and the water came pouring by the hogshead down the companion-way and through the steerage hatch. Everything was swept from the table though secured in the manner usual in such weather; and some of the family, mattresses and all, were thrown from their berths into the cabin. On deck one of the boats was stove, and the ship in her whole length was washed by

the wave. The gale continuing to increase, and the sea to rise at a fearful rate, it became necessary for our safety to have the upper yards and masts sent down. The seamen were obliged to mount to their very tops, a distance of seventy or eighty feet from the deck, to unloose the rigging; where

> "Upon the high and giddy mast,
> In cradle of the rude imperious surge,"

they were swung, every successive minute, with incredible velocity, through a space of little less than ninety feet: while an inevitable grave yawned beneath them should the slender yard to which they clung give way, or they once lose their footing. The unnatural sound of their voices, as their screams to make themselves heard below were caught by the wind, and borne away on the tempest, came to the ear like the shrieks of the dying; and I dared scarce look up for a moment, lest I should see some one, in despite of every effort, thrown into the raging sea where no power of man could have secured him' rescue. Anticipating the expression of hopeless horror which the wretch thus perishing must give, I often involuntarily closed my eyes in the fear of beholding the agonizing reality. The storm raged till evening with unabated violence, and produced greater anxiety than any we had before experienced. A tempest, such as this has been, is indeed indescribably sublime, but too dreadfully terrific when at its height to allow of much enjoyment. When it begins evidently to abate, and hope tells you that the worst is known, you are left to the indulgence of unmingled and enthusiastic admiration, and may gaze with delight at the evervarying scene, as wave after wave rears its monstrous head and casts its foaming honors to the clouds. But till this change does take place — while every successive blast blows harder and harder, and each billow threatens more surely than its precursor to bury you under its weight, — it is impossible but that thoughts of fear must check if they do not take entire place of the higher feelings of admiration.'

SCIENTIFIC TRACTS.

VOL. II......NO. VIII.

AGRICULTURE ILLUSTRATED BY CHEMISTRY.

SECOND PART.

OF SOILS.

Experience and every day observation show us, that the rocks which are found upon the surface of the earth are daily undergoing changes in consequence of the action of water and the air upon them. The texture of some is partially destroyed and they crumble into pieces of different sizes. Soils appear to have been originally formed in this manner, by the action of air and water on the rocks of our globe. We may have a faint idea of the manner in which the necessary changes are produced, by following the changes which are produced upon a single rock, we will instance *soft granite* (see Geology, p. 35.) Granite is composed of three separate and distinct ingredients, quartz, feldspar, and mica. The quartz is nearly pure silica or flint. The feldspar is composed of silica, alumina (*pure clay*) oxide of iron, (*iron rust*) potash, and lime; while the mica contains silica, alumina, oxide of iron, lime, and magnesia. When a rock of the above kind is exposed for a long time to the influence of air and water, the feldspar and mica are acted upon first, and the lime and potash which they contain are changed by the water and carbonic acid of the air, into other combinations; the oxide of iron is still further oxidized (*rusted*) by the oxygen of the air; the conse-

quence is, the feldspar and mica are decomposed, the feldspar most rapidly however. The feldspar will form clay; the mica will assist and form sand, while the quartz remains and forms gravel or sand. As soon as a thin layer of earth is thus formed on the surface of a rock, the seeds of mosses and other imperfect plants, which are always floating in the atmosphere, catch upon it and begin to vegetate, attain their maturity, die, decay, and are decomposed, and thus form a quantity of vegetable matter which mixes with the earthy parts of the rocks; in this soil, thus manured, more perfect plants take root and grow, and in their turn receive nourishment from water and air, grow and decay as the former, and thus add something to the soil. Thus, by slow and gradual causes a soil is at length formed capable of supporting the noblest class of plants, and fitted for the labor of man. This is supposed to be the manner in which common soils are formed; but there are other soils to which it does not apply, such as peat soils, meadows, and some kinds of swamps.

Formation of Peat Soils.

Peat soils, meadows, and swamps, are found in low situations or surrounded by higher land from which they receive water.

When many generations of vegetables have grown upon a soil, unless part of their produce has been carried off by man, or consumed by animals, the vegetable matter increases very fast, and the soil becomes similar to a peat, and where water can flow upon it, it becomes spongy and is gradually rendered unfit for the support of trees and other large plants. This appears to be the manner in which peat soils are formed, and some meadow soils. The soil of the meadows which skirt the numerous rivers and small streams of New England appear to be formed in a similar manner, only the accumulation of vegetable matter appears to have been stopped before it reached that condition necessary for peat. Many of our meadows have a soil only a few inches in depth, while others are a foot and more. Many of our meadows in the inte-

rior were cleared from swamps, while others were found by our forefathers cleared and covered with a luxuriant verdure; the formation of all, however, appears to have been the same — the continued accumulation of vegetable matter.

In Ireland and Scotland there are large districts of soft spongy soil, called peat mosses, which appear to have been produced by the improvident use of the axe, by the early settlers of the country. They cut down the trees on the outskirts of a forest and thus left those in the interior exposed, and as they were deprived of their natural shelter, they became unhealthy and died, the leaves and branches gradually decomposed and thus produced a superabundance of vegetable matter. This is supposed to be the manner in which the bogs of Ireland were produced, because the remains of trees found in them, always have the mark of the axe on the outskirts, while in the interior no such marks are found, as the trees probably fell by natural decay.

Formation of Spurious Peat.

Lakes, ponds, and pools of water are sometimes filled up by the accumulation of the remains of such plants as grow in water; in this case a sort of spurious peat is is formed. This is the formation of many swamps, particularly in our Southern States. The neighborhood of such soils as have been formed by the decay of *aquatic* plants is always unhealthy, because of the great quantity of noxious gases which are given out, while the true peat soils are healthy and their vicinity is not contaminated with poisonous air, because the bottom on which they rest was originally dry.

All peat and meadow soils are composed of the remains of vegetables mixed with earths, and the kind of earth found in peats is always found to be the same as the stratum or bottom on which they rest. These earths were derived from the vegetables whose decay has formed the peat, and the plants obtained from the soil in which they grew. Thus where this bottom is chalk (*carbonate of lime*) lime is found in the ashes of the peat, which

also contain oxide of iron (*iron rust*) and sulphate of lime (*gypsum*) both of which were formed by the decomposition of sulphurate of iron (*pyrites, or sulphur and iron*) which is always found in chalk.

Poor and hungry soils, such as are produced from the decomposition of granite and sandstone rocks, often remain for ages with only a thin covering of vegetation; while soils from the decomposition of limestone, chalk, marble, &c, are often covered by nature with grasses, and afford when tilled by man a rich bed of vegetation for almost any kind of cultivated plants.

From the manner in which soils are formed it is evident that there must be as many kinds of soil as there are varieties of rocks on the surface of the earth, in fact there are many more. Cultivation and human labor have produced great alterations in soils, and the different materials of rocks have been mixed and transported from one place to another by numerous great alterations that have taken place in the system of our globe, to which if we add the constant operation of water we shall have a sufficient cause for the wonderful effect.

Classification of Soils.

To attempt the classification of soils with scientific accuracy is impossible, and would be useless. Farmers adopt a few names, which probably are sufficient for all practical purposes, particularly if a little precision is used in their application.

Sandy Soils. This term should not be applied to any soil which contains less than seven eighths of sand.

Clayey Soils should apply only to such as contain at least one sixth of impalpable earthy matter and is considerably adhesive.

Loam, should be limited to such soils as contain at least one third of soft impalpable earthy matter.

Peaty Soils, are such as contain at least one half of vegetable matter.

Alluvial Soils are such as have been formed by the deposits of rivers along their banks; in New England these are called *intervale;* many of which are extremely fertile and of very different composition.

Of discovering the Qualities of Soils.

The quality of a soil and its value to the farmer may be ascertained by the kinds of plants which naturally grow on it, or by chemical analysis, or by inspection and handling; the first is considered the best for all common purposes, because analysis is too difficult for most farmers to perform correctly.

Poor thin sandy soils are known in New England by the growth of pitch pine. Rich alluvial or intervale soils generally are covered when in a state of nature with a luxuriant growth of Elm, Hickory, and Sugar maple. Strong loamy soils are generally covered with a thick growth of oaks, maple, yellow birch, beech, &c. Cold loams always have a considerable portion of white birch. But these criteria, however, are not always depended upon, as they sometimes fail. Peaty soils and such as contain a considerable portion of salts, are known by their appropriate plants.

Some of the essential qualities of soils may be ascertained by a simple examination: the presence of clay is known by its tenacity, smell, and taste. Sand is known by its roughness. Limestone soils are easily distinguished by pouring a little diluted acid upon a small portion of them, by the frothing (effervescing) of the soil. The quantity of vegetable or animal matter contained in a soil, may be ascertained by drying the soil and then exposing it to a red heat, the weight lost will nearly equal the quantity of these matters contained in a soil. The color of a soil will indicate the presence of iron, as it will then be red or yellow.

Of the Uses of the Soil to Vegetation.

Soils serve to support plants and enable them to maintain that position which is natural for them. The mere sand, gravel, and clay of a soil is useful as a medium for the conveyance of food to the roots of plants. We have shown in our former number that every part of a soil is useful, to a certain degree, as food for plants, but water

and decomposing vegetable and animal substances *(manures)* are the essential parts of every soil.

As different vegetables have different roots, so they require different soils; tuberous rooted plants *(as potatoes)* require a looser and lighter soil than such as have fibrous roots *(as indian corn)*; and such as have only short fibrous roots *(as wheat &c,)* require a firmer soil than such as have tap roots *(as clover, beets, and carrots.)*

The fine parts of a soil are such as give tenacity to a soil; and a very small portion of these is sufficient to give a soil the property of producing certain kinds of plants, such as turnips, &c. Too large a portion of finely divided matter is injurious, hence, the reason of the practice of covering swamp soils with a layer of sand and gravel, converting them from barren swamps into fruitful meadows.

The fertility of a soil depends greatly upon its power to absorb water; and this quality of a soil depends upon the state of division of its parts, the finer this is, the greater is the absorbent power; fine sand will absorb more than coarse gravel; and clay more than fine sand. The fertility of a soil depends greatly upon the power of the soil to absorb moisture from the air, and the greater this power is, the less liable is vegetation to dry up. If water is poured upon clay, it will absorb a large quantity of it, but clay or clayey soils will not absorb much water from the air, because they cake and prevent the action of the air upon the interior parts. The soils that are most absorbent of water from the air, are such as have a due proportion of sand, clay, carbonate of lime, *(limestone)* and animal and vegetable substances; lime and vegetable substances are the best promoters of this quality of the soil, and the most fertile soils always possess this property in the greatest degree.

The absorbent powers of soils should vary with the climate; where rain falls in abundance this power should be less than in warm and dry countries.

The absorbent and retentive qualities of soils, depend much upon the sub-soil or stratum on which the surface-

soil rests. When a soil rests upon a bed of rock or stone it is much sooner dried by evaporation than where it lays upon clay or marl. A clayey sub-soil is of great advantage to a sandy soil, because the clay is retentive of moisture; and a sandy or gravelly sub-soil may correct the absorbent qualities of a clayey soil.

Farmers distinguish some soils as cold or hot, which may appear to some as prejudice, but is philosophically just, and is of great importance to the practical man. Soils that consist of a light colored clay, cannot be easily heated, and on account of the moisture they contain, they soon lose their heat. Black soils which contain considerable finely divided vegetable matter, is most heated by the sun and air; and generally, the darker the color of the soil the more it is heated. Many cold soils may be improved by draining and mixing charcoal dust with them.

Chemical Action of Soils.

Several parts of soils have an action on some of the principles of animals and vegetables which is entirely chemical. Alumine (clay) is found in almost all soils and if an acid solution of this earth be mixed with a solution of soap *(alkali and oily matter)* the acid will leave the alumine and unite with the alkali of the soap, while the alumine and oily matter unite and form a compound. The same effect is produced when any animal or vegetable decomposing matter, is mixed with a soil containing alumine (clay) or carbonate of lime, *(slacked lime, limestone, chalk)* they unite and form a new substance, which is not so easily dissolved or decomposed as the simple vegetable or animal matter *(manures)*. Therefore, soils containing clay or lime will preserve manures which are applied to them, and are truly rich soils; while such as do not contain lime or alumine, as common sandy soils, are very properly distinguished as poor, *hungry* soils, because they soon lose any vegetable or animal manures which are applied to them, as there is nothing in the soil to attract them, and prevent the air and water from having a free action upon them.

Of the Improvement of Soils, exclusive of Manures.

Soils may be improved in several ways without manures, and their produce of useful vegetables much increased; the principal ones are, pulverization, an alteration of their constituent parts, draining, or watering, and by consolidation.

Pulverization. It is well known that plants will not grow in a soil which is too hard and compact to admit of the free admission of air, water, and heat; as well as for the extension of the roots of plants. Hence the utility of the plough and hoe, to render the ground light, to give free scope for air, water, heat and for the extension of roots. An abundance of roots is essential to the thrifty growth of most plants, and pulverization promotes the formation of roots and fibres. Hence the utility of stirring the soil after the plant has begun to grow, to increase the formation of roots and fibres. Pulverization also, increases the power of the soil to absorb moisture from the atmosphere, by rendering it something like a piece of sponge. Hence the utility of hoeing plants when in the ground dry, because it increases the absorbent powers of the soil. Therefore, the old custom of hoeing when the ground is moist is not founded on truth. A soil is much more heated by the air, when laid light than when compact; because the earths of a soil are bad conductors of heat, and could not be readily heated by contact only, and therefore require the free ingress of warm air, to produce a genial warmth. Pulverization also increases the food of plants, by enabling water, which contains carbonic acid, to pass freely to the roots; it also exposes the manures of the soil to heat, light, &c, which produces fermentation; thus preparing them to answer as food for plants.

Alteration of the parts of soils may be produced either by adding what is deficient, or taking away that part which is in excess, or by changing the nature of some of their parts by fire.

To ascertain the composition of soils which are unproductive, in order to improve them by an alteration of their parts, it is necessary to compare them with fertile soils in

similar situations, and the same neighborhood; the difference may in some cases, indicate the proper method of improvement. If the fertile soil contain a large quantity of sand in proportion to the barren soil, the improvement will consist in adding sand; and if deficient in clay or lime, these substances are to be added. If a soil contains acid or the salts of iron, although otherwise of a good texture and composition, it cannot produce the noble class of plants. If a soil contains sulphate of iron *(copperas)* the proper remedy will be a top dressing of lime, which will convert the copperas into oxide of iron *(rust)* and sulphate of lime, *(gypsum or plaster of Paris)* thereby adding two useful manures to the soil; the same process would be proper for all *sour soils*. Where a soil contains too much lime, a dressing of sand will improve it; and sandy soil would be benefited by a dressing of clay or marl or even swamp mud, which contains much remains of vegetable matter. Soils having the nature of peats, are rendered exceedingly productive by draining and a dressing of sand. The materials necessary for these purposes are generally found near at hand. Many of the poor sandy soils of New England might be greatly improved by the bog mud which is always found in the low places of such soils. Beds of sand and gravel are almost always found below clay. The labor and expense of improving the composition of soils is always repaid by a lasting advantage — less manure is required, and the productiveness of the soil insured forever.

Burning or the changes which may be produced on a soil by fire, has been long practised in our country on new soils; less, however, with a view to improve the soil than to clear the ground of wood.

Soils which contain a large portion of dead vegetable matter or which are composed of stiff clay, may be economically improved by removing the top sod, drying it and then burning it on the soil, or if covered with wood by cutting it down and burning it on the ground. The effect of fire on the soil is, that it renders it less compact, lighter, and not so retentive of moisture; and when properly applied it will render a stiff,

damp and cold soil into one dry, powdery and warm; but where a soil already possesses these essential qualities fire must be injurious, because it will destroy a portion of the vegetable matter in the soil. It is evident then, that sandy soils are injured by burning. We have seen the experiment tried on a large scale in New Hampshire, of clearing a sandy soil without fire. Four acres of *pine plain*, had the wood and under brush cut and carried off clean, and then sowed with winter rye and grass seed. Adjoining to this was another piece of the same kind of soil, having a similar exposure, which was cleared in the usual way by fire, and sowed at the same time with rye. The first piece yielded 40½ bushels of rye to the acre, while the piece burnt over, yielded only 21 bushels to the acre; and the former piece has since yielded much more pasture feed than the latter. Here the fire burnt up the vegetable substances of the soil and left it poor.

Draining and Watering. Where a soil contains too much water it may be withdrawn, and where deficient it may be supplied. Where a soil rests upon a sub-soil or bed, which does not permit water to pass through it with facility, the water will collect on the surface and become stagnant, which obstructs the free circulation of the juices of plants and thus injures the growth of all useful plants. Hence the utility of surface draining, or small ditches and gutters. Some soils are full of springs, which causes them to be cold and unproductive, and hence, the origin, and utility of drains under the surface, to convey away the superfluous water. River water is injurious to vegetation when used excessively; and hence the utility of embanking, as practised with so much success in Holland and Italy. There are many methods of furnishing a soil with water when required. Surface watering is produced by conveying the water in open channels. This is the method we read of in the Old Testament, as practised by the children of Israel while under bondage in Egypt. Under irrigation is produced by conveying water to the soil in covered drains.

In many parts of New England meadows are flooded

in the fall of the year, and during the winter, with a beneficial effect. 1st. Because the matter is generally impregnated with animal and vegetable matter, *(manure)* particularly, if the stream flows through a cultivated region; 2d. Because the water penetrates deep into the soil, and in a measure, prevents the soil from suffering from a long draught. 3d. If the stream flows over limestone, it is impregnated with this earth, and it is deposited upon the soil. 4th. In cold seasons it preserves the roots and leaves of the grasses from being injured by cold; but in all cases, where a soil is irrigated in fall and winter, it should be so disposed, either by nature or art, as to prevent the water standing upon parts of it, after the mass is drawn off in the spring.

Consolidation. Every gardener knows the benefit of treading in seeds, on some kinds of soil; and the utility of the roller is beginning to be appreciated by our best farmers. — Porous and loose soil are much benefited by being compressed, particularly after receiving a dressing of loam or sand. Light sandy soils are much improved by the use of a good roller.

Some soils, such as light sandy ones, may be improved and made to produce more grass and other herbaceous plants, by shading the surface with trees, thereby increasing the produce of such soils in feed for cattle, and promoting the growth of some useful timber trees; because, shade will intercept the heat, and therefore, prevent the free evaporation of the moisture of the soil.

There is one other means of improving a soil without the use of manure, by growing different kinds of plants in succession upon the same soil; this is called a *rotation of crops.*

It is well known that all plants will not thrive equally well on the same soil; because, some require a particular part of the soil to perfect their seeds, while others require another part. Therefore, if the different kinds of vegetables are planted in succession on the same soil, each one will deprive it of that particular principle which is is suited to its nature. This kind of rotation is found

to take place in nature. Black and gray ash is generally found to succeed a growth of pitch pine. New lands produce strawberries and dwarf blueberries, and in a short time they exhaust the soil of the particular principle necessary to their healthy growth, and then decay and disappear, and are replaced by other plants. The manner in which certain plants *travel* from one place to another is well known, as mint, crow-foot, &c.

The following general principles have been laid down as to the principle of rotation of crops.

1. All plants exhaust the soil more or less.
2. All plants do not equally exhaust the soil.
3. Plants of different kinds do not exhaust the soil in the same manner.
4. All plants do not restore to the soil the same quantity or quality of manure
5. All plants are not equally favorable to the growth of weeds.

The following consequences may be drawn from these principles.

1. However well a soil may be prepared, it cannot long nourish crops of the same kind in succession, without becoming exhausted.
2. Every crop impoverishes a soil more or less, according as more or less is restored to the soil as manure, from the decay of the plant cultivated.
3. Perpendicular rooted plants, *(clover, beets, &c,)* and such as root horizontally *(wheat, indian corn, &c,)* ought to succeed each other.
4. Two plants favorable to the growth of weeds, ought not to follow each other.
5. Such plants as greatly exhaust the soil *(as the grains and indian corn)* should only be sown when the land is in good heart.
6. In proportion as a soil is exhausted by successive crops, plants which are less exhausting ought to be cultivated.

ON MANURES.

Every species of matter capable of promoting the growth of vegetables may be considered as manure.

In our former number we have shown that the food of every species of vegetables is composed of compound substances, which are combinations of four gases, oxygen, hydrogen, carbon, and azote, together with some kinds of salts; therefore, whatever is used as a manure must be composed of these same elementary substances. All animal substances contain these elements, and all vegetable substances contain them all except azote, which however is found in a small number of plants; and certain saline substances are always found in healthy vegetables and animals; manures then may be divided into animal, vegetable, and saline, or mineral. This branch of agriculture is greatly indebted to the labors of Sir Humphry Davy, who was the first to explain the subject in a clear and scientific manner.

Of Animal and Vegetable Manures.

Decaying animal and vegetable substances are by far the most useful class of manures. We shall consider the theory of their operation, their specific kinds, their preservation and application to the soil.

We have already stated as a general principle, that no solid substance can pass into the organs of plants in a solid state. And it is equally certain, that the proper food of plants is either such substances as are soluble, or such as are capable of being converted into aeriform matter.

It has been found by universal experience, that animal and vegetable substances deposited in a soil, are consumed during the process of vegetation, and they can only nourish the plant by affording substances capable of being dissolved by water, or gaseous matter; but, the gaseous substances pass into the atmosphere, and therefore must produce but a small effect, as they are soon mixed with the surrounding air. The great object then, in the application of manures, should be to make them afford as much soluble matter as possible to the roots of vegetables, in a slow and gradual manner, so that it may be entirely consumed by the plant in forming its organizable parts.

There are but few vegetable substances which in their natural state are soluble, therefore, they must undergo some change to fit them for the food of plants.

If any fresh vegetable matter which contains sugar, mucilage, starch, or other vegetable compound, which is soluble in water, be moistened and exposed to a temperature from 55° to 80° in the air, oxygen gas will be absorbed, and carbonic acid gas *(fixed air)* will be given out; heat will be generated, and then several kinds of gases will be evolved, and a sour or bitter dark colored liquid will be formed; and if the process continue sufficiently long, nothing solid will remain, except earthy and saline matter. In proportion as there is more matter soluble in water, other circumstances being equal, will the process be more rapid. It is in this manner that all vegetable substances are reduced to a fit state for becoming the food of plants, in other words, *rotted.* Pure woody fibre undergoes this change but slowly, unless mixed with some substances which are very liable to change and rot. Every known vegetable substance may thus be reduced to other substances which are soluble in water, and therefore may be used as manure. Animal matters are more liable to these changes than vegetable substances; oxygen is absorbed and fixed air and ammonia *(hartshorn)* are given out during the process. The produce, as is well known, are various fetid gases, dark colored acid and oily liquids.

From the above considerations, it is evident that whenever a manure consists already of matter soluble in water, it should not be permitted to ferment, or as farmers express it, it should not be allowed to *heat;* and the only cases in which these processes can be useful, are, when the matters consist principally of substances which are not soluble in water, such as wood and similar substances. To prevent manures from decomposing or *heating*, they should be kept from water as much as possible; hence the utility of manure sheds, which are beginning to come into fashion; manures should also be kept as free from the air as possible, and cool. Common salt and spirits it is well known, will preserve meat and vegetable sub-

stances, because they attract the moisture from them and prevent the decomposing effects of water.

Of the specific kinds of Animal and Vegetable Manures.

The difference between the various kinds of manure is of very great importance to the farmer, and should be clearly and distinctly known by every cultivator of the soil, because different manures contain different proportions of those elements which are necessary for the food of vegetables, and of course require a different treatment to enable them to produce their full effect when applied to a soil.

Green juicy plants contain much saccharine (*sweet*) and mucilaginous (*gummy*) matter, and of course readily undergo fermentation, which will break down and render soluble the woody and hard parts of the plants. When intended therefore for manure they cannot be used too green, in order that they may *heat* in the soil, and thereby prevent the escape and waste of their useful parts. Green plants contain the largest quantity of easily soluble matter when they are in flower or just before. Green plants, pond weeds, sods, &c, require no preparation to fit them for manure, and if buried in the soil the soluble matters are slowly dissolved, and the slow manner in which they rot or decompose prevents the loss of elastic matter, owing to the want of a free communication of air.

From a proper consideration of the above principles, we may see the utility of sowing seed, raising plants, and then ploughing them into the soil, to answer as manure for succeeding crops.

Rape-cake, malt-dust, and *linseed-cake* have been used as manure in some instances, and with great success, but their utility for other purposes, and scarcity, prevent their general use among our farmers.

Sea-weeds, consisting of different kinds of sea-plants, are extensively used as a manure on our sea-coast. Those who have used this substance as a manure know that it answers for but a single crop, which is easily accounted for from the large quantity of water which it

contains. It is evident then, that sea weeds, as a manure, should be used as green as possible; fermentation destroys the greater part of their nutritive qualities for the food of plants.

Dry straw, *spoiled hay*, *corn-stalks*, &c, in all cases are useful manures. It is customary with our farmers to rot these substances before using them, by which means the greater part of their parts which are soluble, is destroyed and lost. Fermentation will render straw a more manageable manure, and when intended for a single crop it is better; but the soil is less improved than it would be, if the whole of the vegetable matter (*straw, &c,*) were finely chopped and mixed with the soil dry. In this case it would rot in the soil without any loss whatever.

Woody fibre, such as tanners' spent bark, chips, saw-dust, &c, seems to be the only vegetable matter which needs fermentation or rotting, to fit it to become vegetable food. These substances are very retentive of moisture, and therefore cannot be easily rotted without the assistance of some other substance which will ferment, such as dung; the fermentation abstracts a part of the carbon (*charcoal*) of the wood, and brings such substances into soluble principles; this is done by the absorption of oxygen and the formation of carbonic acid (*fixed air*).

Peaty matter, such as meadow-mud and similar substances, which contain roots and other vegetable matter, remain for years exposed to air and water, and yet will not heat and rot; therefore, such substances, in their natural state, cannot afford plants much nourishment. The best mode of bringing such substances into matter fit for the nourishment of plants, is to mix it intimately with common farm-yard dung. One part of dung is considered sufficient to bring four parts of peaty matter into a state fit to be applied to land. The more such mixtures heat, and the more readily it ferments, the better will it be fitted for the purpose; if a quantity of living vegetable substances mixed with the peat, the more rapid will be the fermentation; because, this has a great tendency to undergo this change.

Manures from animal substances generally require no chemical preparation to fit them for the soil. The great object of the judicious farmer will be to blend them with the soil as intimately as possible, to prevent their too rapid decomposition. The entire parts of land animals are seldom used as a manure, though there are some cases in which such an application might be made. Horses, dogs, sheep, &c, that have died accidentally, or of disease, are frequently suffered to remain exposed to the air until they are entirely destroyed by birds and beasts of prey, contaminating the air around with poisonous gases. By covering dead animals with a coat of quick-lime and then a thick layer of soil, in a month or two they will be found decomposed, and the soil will have become impregnated with soluble matter, so as to become an excellent manure.

Fish forms a very powerful manure in whatever state it is used; a small quantity ploughed in fresh, will produce a powerful effect. Fish contain all the principles necessary for the food of plants in a very soluble state, which accounts for its powerful effects. The writer has seen a most luxuriant field of corn, growing on a poor hungry soil manured with one small alewive to a hill.

Bones of late years have become a favorite manure, particularly in England. The ground on which many bloody battles were fought during the wars in Europe have been examined, and the bones of the slain, horses and men, carefully collected and exported by ship-loads to Great Britain, where they are ground up and applied as manure; a melancholy and degrading illustration of the passion for war. Bone is formed of earthy salts, the principal of which are found in plants, together with fat jelly, &c, which accounts for its powerful effects. That great practical and scientific cultivator, Hon. J. Lowell, has lately applied the bones of horned cattle to his meadows with great advantage.

Horn, hair, woollen rags, &c, are very powerful manures, as they all contain a large proportion of decomposable animal matter. The earthy part of horn and bones *(lime, &c,)* prevents the too rapid decomposition of the animal matter, and renders them very durable in their effects.

Urine has been long known as an excellent manure. Urine is very liable to putrefy on account of the quantity of gelatin *(animal jelly or glue)* which it contains; and that of carnivorous animals *(such as feed on flesh)* more rapidly than that of graminivorous animals *(such as feed on vegetables)*. All kinds of urine contain a large quantity of the elements of vegetables in a state of solution; but during the putrefaction of urine the greater part of soluble matter is destroyed; therefore, it should be used as fresh as possible, and mixed with earth or water, as it is too strong to form a proper fluid nourishment for plants. Putrid urine, although less active than fresh urine, is a very powerful manure, and every good cultivator will preserve it.

Dung of Birds. This is among the most powerful manures, particularly the excrements of such birds as feed on animal food, as sea birds. The *guano*, which is used extensively in South America is a substance of this kind; it is used particularly for Indian corn. The dung of birds has been but seldom used as a manure in this country, on account of its scarcity; no doubt it might be found on many of the small islands on our eastern coast, and from thence might be transported to the main land with profit.

Night soil, it is well known, is a powerful manure; and always contains abundance of those principles which constitute vegetable food. The disagreeable smell of night soil may be easily destroyed by quick lime; and if exposed to the air in thin layers, it soon dries, forming a mass easily pulverized and without smell. In this state it is an article of commerce in France, under the name of *poudrette.* In England it is sold under the name of *desiccated night soil.* The dung of domestic fowls is another powerful manure; it is very soluble in water and contains many of the ingredients found in urine; hence, its powerful effects on vegetable growth. The dung of fowls and pigeons is used by tanners to bring on a slight degree of putrefaction in skins which are to be made into soft leather. The dung is dissolved in water and then it rapidly undergoes putrefaction and

brings on a similar change in the skin. In all cases, the contents of the *grainer*, as the vat is called, when mixed with soil will form a powerful manure.

The dung of cattle, horses and sheep, contains a large quantity of matter soluble in water, which substances are exactly similar to the soluble parts of the vegetables on which they feed. The part of dung which is not soluble appears to be merely woody fibre. In the treatment of the pure dung of cattle, horses and sheep, there is no reason why it should be made to ferment, except in the soil like other pure dungs, or, if suffered to ferment, it should only be in a slight degree, merely to bring on a disposition in the woody fibre to change. The grass in the neighborhood of recently voided dung is always coarse aud dark green ; many persons suppose this to be owing to some noxious quality in green manure, but it is rather the result of an excess of food furnished the grass.

Of the fermenting, preserving, and applying of Vegetable and Animal Manures.

The value of organic manures as food for plants depends very much upon their management. The great mass of manures used by the farmer are a mixture of animal and vegetable matters. Should these be allowed to *heat* or ferment ? And how may they best be produced when not immediately wanted ?

As woody fibre is greatly in excess in the refuse of a farm-yard, a slight degree of heat or fermentation is necessary to induce this to begin the decomposing process when it shall be placed in the soil. Any excess of fermentation tends to destroy and dissipate the most useful parts of manure ; and the ultimate result of the *heating* or fermentation, is similar to that of combustion ; it is only the indestructible parts that are left after the process. A violent fermentation will reduce green manure one half or two thirds in weight, occasioned by the loss of gaseous matter, (*fixed air and ammonia*) which in the soil might become a useful nourishment of plants. In

addition to the loss of vegetable food by fermentation, there is another loss, the loss of *heat*, produced by the action, which if produced in the soil, would promote the germination of the seed and assist the plant in the first stage of its growth. In addition to these reasons, it is a general principle in chemistry, that substances combine (of a gaseous nature particularly) much more readily at the moment of their disengagement, than after they have been perfectly formed. By allowing the manure to ferment beneath the soil, all fluid matter produced is instantly applied, even while warm to the roots of plants, and therefore is more liable to be efficient. Checking the fermentation of a dunghill by covering with earth or by water is wholly inefficient; spreading the manure in dry weather is the only means of stopping the *heat*.

Of Manures of Mineral Origin.

Manures of lime, plaster, and other saline substances, are of more recent invention, and doubtless of more uncertain use, than those we have just described. The conversion of matter that has belonged to plants into the same forms again, is a process that can be easily understood; but it is more difficult to follow those operations, by which earthy and saline matters are converted or consolidated in the fibres of plants.—These are capable of great elucidation by chemistry. We shall describe the theory of their operation, and some of the most common kinds used.

Theory of the Operation of Lime, Plaster, &c.

Some philosophers have attempted to prove that plants receive from the soil and air only the elements of vegetables, and by the power of *life* they convert these into, and form the various substances found in them. But the general results of many experiments are entirely opposed to such doctrine. The ashes of the glass-wort (*salsola soda*) when it grows remote from salt water contains potash, and when it grows on the sea-shore it affords soda. The sun-flower when growing in soils containing

no nitre (*salt-petre*) does not afford this salt, though when watered with a solution of this salt it yields it in abundance. It has been conclusively proved that the ashes of plants are always similar in constitution, to the soils in which they grow. It is a fair conclusion then, that the different earths, salts, &c, found in plants, are supplied by the soils in which they grow, and in no cases are composed by a new arrangement of the elements which constitute these substances. It may be received as a truth in the structure of plants, that compound substances are uniformly produced from simple ones; and the elements in the soil, the atmosphere, and the earth, are absorbed and made parts of beautiful and diversified structures. These views of the subject lead to correct ideas of the operation of mineral manures. They produce their effect, either by becoming a constituent part of the plant, or by acting upon its more essential food, so as to render it better fitted for the purposes of vegetable life.

Of the different kinds of Mineral Manures.

Lime in different states is the most common manure of this kind, quick lime, slacked lime, plaster (*pure lime and oil of vitriol*) or sulphate of lime, are used as manures. Quick lime in its pure state is injurious to plants, but slacked lime (*lime combined with fixed air*) is a useful ingredient in soils under the form of limestone, chalk, &c. When newly burnt lime or unslacked lime is mixed with any moist fibrous, vegetable matter, there is a strong action between the lime and vegetable matter, and they unite, forming a compound which is partially soluble. By this operation lime renders vegetable matter, which was before insoluble and inert, nutritive; and as charcoal and oxygen abound in all vegetable substances, the lime becomes slacked or carbonate of lime (*lime-stone, chalk, &c.*) Mild lime, powdered limestone, marls, &c, have no action of this kind on vegetable matter; and the action of quick lime and slacked lime depends entirely upon different principles. Quick

lime in being applied to land, tends to bring all hard vegetable substances into rapid decomposition and solution, so as to render them a proper food for plants. Slacked lime, marl, &c, will only improve the texture of the soil, and act merely as one of its ingredients. Therefore, lime should be applied for quick lime, or just as it is slacked, thereby f· ming new food for plants, and as it soon becomes mild lime, it then acts in altering the texture of the soil. Hence, the utility of lime on all soils that contain much insoluble matter, as peats, swamps, &c.

Lime promotes fermentation. In all cases in which fermentation is useful to produce vegetable food, lime is always efficacious. Lime will extract vegetable food from tanner's spent bark.

There is one kind of lime used in this country as a manure, with great advantage in some local situations; this is oyster shells, which consist principally of carbonate of lime. The operation of this manure is the same as other carbonates of lime; with the advantage of a portion of animal and saline matters which are attached to the shells. They are ground up and strewed over the soil.

General principles for applying lime. Quick lime should never be applied to a soil unless it contains much inactive vegetable matter. Mild lime, marl, &c, should never be applied to a soil that already contains much calcareous matter. Lime always destroys a part of all animal matter, either by combining with some of their elements, or giving them new arrangements. Lime should never be mixed with common dung as it renders the extractive matter insoluble.

Of Gypsum or plaster of Paris. Gypsum or plaster is lime combined with sulphuric acid, (*Oil of vitriol*) and has been extensively used in many parts of the United States as a manure.

Very discordant notions have been formed as to the mode in which plaster operates to promote the growth of some plants. Some supposed it acted by attracting moisture; others supposed it assisted the rotting of manures.

The ashes of clover, wheat, Indian corn, &c, afford considerable quantities of plaster, and this is supposed to constitute an essential part of their woody fibre. If this be admitted, it is easy to explain the reason of its operation; if the soil does not contain plaster in sufficient quantities for the purpose of vegetable growth, of course a dressing will assist the growth of such plants as it constitutes a part of. Where a soil is not benefited by plaster, it is owing to its already containing enough. Hence plaster has no effect after a certain number of applications. The best cultivators apply plaster annually to grass lands, in the spring. Plaster has been found very efficacious on clayey soils, as it prevents the baking of such soils.

Wood ashes consist principally of potash, or vegetable alkali united to carbonic acid; and as this substance is found in almost all plants, it is not difficult to conceive that it may form an essential part of their organs. The general tendency of wood ashes is to give solubility to vegetable matters; in this way they render charcoal and other substances capable of being taken up by the tubes of plants. The effect of *leached* ashes is similar, only not so active, because the ashes have been deprived of the most of their alkali.

Thus have we detailed in a brief and practical manner the chemical properties of manures, together with the theory of their actions; the whole of which forms a beautiful illustration of the order and economy of nature in the formation of vegetable structures. By the death and decay of animal and vegetable substances they are separated into their constituent parts, thus preparing them to again become the organs of living bodies. The rotting of such bodies in the atmosphere produces gases which are noxious to man, but when placed beneath the soil these gases become the food of plants, and what is noxious to man, is gradually converted into forms of beauty and usefulness—the perfume of the rose and the farina of wheat; and what was before poison becomes the nourishment of man.

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SCIENTIFIC TRACTS.

VOL. II......NO. X.

I. AGE OF THE WORLD.

II. CAVERNS.

The substance of the earth, so far as it has been examined, consists, as our readers are well aware, of various strata or layers of matter one above another, differing in their nature, thickness and extent. On account of the inequalities of the surface of the earth, and from some other circumstances to be mentioned hereafter, geologists have been enabled to obtain a knowledge of this succession of layers to a much greater depth than that to which the lowest mines have been sunk. For a long time it was supposed that each bed or stratum was extended universally over the globe; that a series of layers in regular succession environed our planet like the coats of an onion. This, however, is not the case, as many beds of rock are common in one district, which are entirely wanting in another; but taken as an illustration of the crust of the globe, the successive coats of an onion, if they were of different colors, might not unaptly represent the different strata that cover certain districts. Wherever similar beds occur together, they lie in the same order of succession over each other. Thus in the valley of the Thames round London, there is, at the depth of a few feet under the surface, a dark colored substance called London clay, under this is a layer of chalk and under the chalk, one of sandstone. This is the invariable order of succession wherever these occur together. The London clay is never found under the chalk, or the chalk

under the sandstone. We are not, however, to infer from this that the outer crust of the whole globe is composed of London clay, chalk and sandstone. In some other places, these would not be found at all.

As before remarked, it is not always necessary to bore through the upper beds to ascertain the order of succession; for the different strata seldom occur in a flat or horizontal position: they generally rise in a certain direction and come to the surface. Sometimes their direction is quite perpendicular. If we take a number of similar planes of pasteboard and lay the undermost a little inclined and place another plane upon it, with the upper edge an inch or more distant from that of the under plane, and again lay the others in succession in the same manner; the uncovered ends, will represent the edges of the strata as they rise from under each other. From this arrangement, it will appear that one series of strata may extend to a greater depth than those surrounding it and also be raised to a great height above them. Thus the layers which form the loftiest mountains are found to extend below the horizontal layers in the vicinity, to the greatest depths yet penetrated by man.

Classification of Strata.

To a great depth below the surface of the earth and also on the mountains to a considerable height above the level of the sea, these strata are found to contain the remains of animals and vegetables in what is called a petrified state, that is, the form and structure are distinctly visible, while the substance is exchanged for an earthy matter. (See Tract No. II. Geology, page 31.) These remains are more abundant in the upper than in the lower strata, and in the lowest that have been explored none are to be found. Hence the latter have been named *primary* or primitive strata, as they are supposed to have been formed before the existence of organized beings. Those which contain none of these remains, are called *secondary*. Between the primary and secondary layers is a class which sometimes contains the zoophites of the ocean, intermediate between animal and plants; but

seldom contain the remains of land animals or vegetables. These are called transition strata, as forming the passage between the primary and secondary. Above these, are beds of gravel, sand and soil, forming the surface of countries. These strata are called *alluvial*, as the particles or fragments of which they are composed, appear to have been deposited by the waters of the ocean or rivers. A country is called *primary*, *secondary*, *transition* or *alluvial*, according to the kind of strata which prevails in it, or forms its basis.

Now in examining their various strata as they present themselves to the view of the geologist, there are strong indications of their having been formed in a very slow and gradual manner. The regularity with which the animal remains are arranged, — the entire distinction between the species and sometimes the genera of those of different strata, — and various other appearances which we cannot now enumerate, indicate a very long course of years, as the period during which the solid crust of the earth was assuming its present form and character.

There are indeed among these proofs of gradual and gentle changes, others of more violent and sudden effects. The strata are sometimes rent asunder and foreign substances apparently introduced into the crevices. They are sometimes found in oblique or almost perpendicular positions, and as they could not have been formed by subsidence in this position, it is probable that they have been thrown up by some powerful cause which has long since ceased to operate.

There are strong indications therefore that a considerable period elapsed, between the time when the materials of which our present earth were composed were called into existence and that in which it finally assumed a habitable state, and became the abode of man, and many christian geologists are accustomed to believe that the word translated *day* in the Mosaic account of the creation, refers to an indefinite period of great length. But however this may be, it is clear that according to the account which the Sacred Scriptures give us that not more than about six thousand years have elapsed since

the earth last assumed a habitable state; and it is very pleasant to the christian scholar to find in the present appearances, and in processes of change which are now going on, the evidences of this comparatively recent formation of the existing exterior of our planet.

There are various natural processes, changes produced by time, by the weather, and by the flow of rivers to the sea, which must immediately commence, upon a globe surrounded with an atmosphere like ours, and left with an uneven surface. In process of time however these changes must have been completed. Sand is never washed up the mountains, but always down towards the sea, and consequently there must be a time at the end of which this process of levelling must stop for want of materials to act upon. We find however all such processes actively going on. The causes of some of these changes now in progress, and indicating that the surface of the earth has assumed, at a comparatively recent date, its present form, we shall now describe.

1. *The weather.* Many of the loftiest mountains are every year becoming lower from circumstances connected with the weather. In the first place during the winter the water in the crevices and hollow places, by being frozen expands, and the earth around is burst away, in the same manner as an earthen vessel is broken by the freezing of the liquid it contains. The fragments are scattered around the foot of the mountain. Again, the fall of rain and the melting of snow in the spring, wash away some portions of the summits. In some cases enormous masses have been detached at one time by the sudden action of accumulated waters, occasioning many dreadful consequences. Whole villages have been levelled and their inhabitants destroyed by the fall of the earth and rocks from the Alps in Italy. By one of these sudden disruptions, which occurred about twenty years ago, four villages, containing in all one thousand inhabitants, were destroyed. An individual who had made an exact model of the Alps and who was therefore acquainted with every part, foresaw that this portion must fall. He gave notice of the danger but was disregarded, and thus many perished who might otherwise have been saved.

Sometimes, instead of the fall of detached masses the whole surface of some declivities, beginning at the top, will become loosened and slip or slide to the bottom, carrying with them shrubs and forests and rocks of enormous size. These are called slides. They are not very common, but they have occurred in the mountains of Vermont and New Hampshire within four or five years. Appearances indicate that there anciently were others in the White Mountains, though no history or tradition of any such exists.

2. *The flow of Rivers.* Almost all rivers take their rise in mountains, or in mountainous districts. In their descent they are constantly wearing away the declivities down which they pass, by washing off the most elevated parts of the soil. This loose matter is deposited lower down the stream. From various sources most rivers are greatly augmented at different seasons in the year, in the winter by heavy rains; in the spring by the melting of ice and snow. At such times they often overflow their banks carrying with them, and depositing upon the land in the vicinity, the substances which they have gathered in their way, thus often greatly fertilizing the soil. This is the case with the Connecticut which every year overflows its banks, in some places forming a deposit, which so enriches the land that the labor of cultivation is very slight. The seed is sown and the plants take care of themselves. Of course these deposits are continually shifting. Those formed in one year are liable to be swept away the next: on the other hand, they may be more widely extended. Thus a farmer who at one time purchased lands on the banks of the Connecticut might by the rise of the river the next year, find a part of it washed away; on the contrary, by an additional deposit, joined to the old one, his possessions may have been increased. Sometimes by planting trees on the shore the land may be preserved from being washed away, the roots serving to hold it together; and thus, in time, are gained extensive tracts of land.

The river Mississippi affords an interesting example of

the effects of alluvial depositions. The subjoined description is the substance of the account furnished by Capt. Hall in his Travels in the United States.

The length of the Mississippi between its mouth and the confluence of the Missouri, is upwards of 1200 miles. Its width is remarkably uniform throughout its whole course, varying but slightly from one half mile. That which gives the river its grandeur is its great depth. From a view of the middle current, its velocity would be supposed very great: but experiments have proved that the whole body of the river moves at the rate of only about one mile an hour; — the friction of the banks with their numerous projections, and the islands in the midst retarding its progress. The inclination of the land over which it has its course, decreases as it approaches its mouth. Between the city of New Orleans and the Gulf of Mexico, into which it empties — a distance of about 100 miles, — the whole slope in the southern direction, is not more than nine or ten feet. During a part of the year the surface of the river is nearly on a level with that of the surrounding country. In the winter its volume is greatly increased. It begins to rise in December or January, and remains full throughout June and sometimes a part of July. During this period the water rises above its banks, and where no measures for its confinement are employed, it overflows the adjacent tracts of country. At the city of New Orleans it is contained within its proper channel by a leveé or embankment, about four feet in height. At high water, the river very nearly reaches the top, affording as viewed from a distance a very singular spectacle. It appears as if the slightest addition would send it over the edge, and thus submerge the city.

These embankments have without doubt the effect of considerably modifying the form of the Delta, or lower part of the river. From a glance at the map it will be seen, that at the entrance of the river into the gulf, there projects a tongue of land which is divided into strips by the passage of the several mouths. At the place where each of these mouths join the sea, there stretches across a bar or shallow bank. These banks and the projection

itself are formed by the mud and other materials, brought down at all times, but especially in the wet season. In this way the Delta is constantly pushing itself into the sea and every successive deposit contributes to raise the bottom of the channel to the surface of the river. Thus it is certain that at some future period, though indeed at one of inconceivable distance, the whole Gulf of Mexico will be a dry and level plain.

On every hand, these deposits are constantly taking place. Portions of the soft alluvial shore are washed down the river, together with thousands of trees which are plunged into the waters by the occasional undermining of the banks. In the spring, the quantity of logs, as these trunks of trees are called, is so great that not only the river but the sea for some miles is coated with them. As the waters subside these settle upon the mud and are cemented together by fresh deposits. In time, a rank sort of cane or reed springs up, which helps to keep them together. This is called a cane-brake. These reeds, by retarding the flow of the river, collect the mud of the next season, and by the process of their own decay, lend their share to form the alluvial soil of the Delta. Fresh logs and fresh mud go on forming for a certain course of years, when a poor kind of shrub takes root and grows up. When these have become trees they collect more soil about them, and land somewhat firmer is connected as we advance from the region of swamps to that of marshes. The intruder man, now begins his operations, by banking out the stream, and taking the farther management of the soil into his own hands. The fertility of such spots exceeds that of any other part of the world. Of course, all the sea-shores or skirt of the Delta are uninhabited, and must remain so until fresh deposits raise the level a few feet more.

From the nature of the country in these parts the river easily cuts its way in any direction, so that, instead of observing a straight course, it winds about, forming itself into loops and bends and a thousand fantastic forms. At some parts of every considerable bend, the velocity of the current will naturally be diminished; in others it will be increased. Wherever it moves most slowly, deposits will

be formed joining the bank ; on the other hand, where it is most rapid, portions will be detached and carried away. Accordingly, it will appear that a town located on some parts of the bank, would be liable to be washed into the the river, while in another would be gained additions to its extent. The city of New Orleans we find placed in a situation favorable for the accession of deposits, and accordingly, instead of being scooped out, and carried away, there have been considerable additions to the land abreast of the upper part of the city.

Every person is anxious to establish his claim to the lands formed, or to be formed, about his property. An instance is related of an individual who conceived the idea of accelerating the process of formation. He obtained a number of the large flat boats called arks, and sunk them one by one, in a line at a short distance from the levee. This impediment to the course of the stream, aided the deposits, and the land continued to rise with much greater rapidity than formerly. The daring project met, however, with an unfortunate defeat; for by some sudden action of the waters, the whole of this newly formed tract, was one night washed into the river, dragging with it besides, a great part of the deposit formerly collected.

Even the system of making artificial levees or embankments is liable in some degree to the same chances, for the waters sometimes burst a passage through, deluging the adjacent grounds. A few years ago, owing to a crevasse, as these openings are called, which occurred just above New Orleans, the greater part of the city was laid under water to the depth of several feet for some months. On the first symptoms of a crevasse in any place, however, the exertions of the inhabitants are united for its arrest.

In those parts of the Mississippi where no artificial embankments have been made, the water of course flows over the bank every year, inundating the whole of the adjacent country. The effect of these overflowings is to form a gentle slope of the land from the edge of the river towards the swamps on either hand ; for the materials deposited become finer and the quantity smaller, as the

velocity of the surplus waters is diminished by finding room to spread itself.

Through the natural embankments thus formed along the shore, the river will in the season of the freshes, cut for itself a new channel along which it can move more easily. At some turns of the river these deviations are partial, acting as mere outlets for the extra water upon the rise of the river, at others, the former channel is entirely deserted, the whole body of the stream having found its way by a new course. At all such turns, where the stream cuts fresh channels for itself in this way, the same series of operations goes on as with the main body; — the banks overflow, deposit, and sloping levees are formed. In process of time, the beds of these new rivers rise, as that of their parent had done before them after which, in due season they break loose, cut openings in their banks, and send off fresh streams to run the same round. In this way the whole Delta is matted over with a web of rivers and natural canals, or bayoux, as the latter are termed, along the banks of which are found the natural embankment before mentioned. As the country becomes settled, these are gradually crowned by artificial levees, and the adjacent country, protected from inundations, yields crops of incredible richness.

The cataract of Niagara is formed by the fall of the river St Lawrence over a ledge of the bed of limestone which forms the basis of the surrounding country. This river takes its rise in the Mississippi. It receives diffent names in different parts of its course, such as the St Marie, Detroit, Niagara, &c; but properly the whole should be called by one. The current is distinctly preserved throughout the lakes, so that it is the same river when it flows out as when it enters. Taken in the whole of this extent, it is one of the most magnificent in the world. The mass of its waters as the outlet to the whole chain of the great lakes, besides its numerous tributary streams, is greater than that of any other river except the Amazon and La Plata. The velocity of its current as it proceeds

out of lake Erie is five or six miles an hour.* The descent of the land, it will be remembered, is towards the north, lake Erie being higher than lake Ontario by nearly four hundred feet. The river declines more or less rapidly in different parts of its course until it reaches the great precipice, which is about one hundred and fifty feet. In breadth the stream varies in different places between the two lakes from one to four miles. Immediately above the falls it is about three miles. The current here is exceedingly powerful, it having commenced a rapid descent a mile and a half above. Immediately as it reaches the precipice it turns suddenly at a right angle, and is instantly contracted from three miles to less than three quarters of a mile in width. Here the whole mass of waters rush down the vast descent with an impetuosity not to be conceived.

The stream is divided at the cataract into two parts by the intervention of Gravel Island: so that the water falls in two distinct sheets, each division forming a river of prodigious size. The effects of the descent from so astonishing a height are amazing. The sound of the mighty rush fills the surrounding country. It may be heard distinctly at the distance of twenty or thirty miles, and oftentimes of fifty. The whole surface of the river beneath the precipice is rendered one entire bed of foam, from which the mist ascends in one immense cloud, spreading in all directions in wild and fantastic forms. Rainbows of the most brilliant hues may be seen in proper positions when the sun shines. The whole forms a scene, by every beholder pronounced one of unparalleled magnificence.

The circumstance which most claims attention in this place is, that this cataract was once at Queenstown, a distance of seven miles from the present spot. At that place is the brow of the great bed of limestone over which the river has its course. The same bed extends for a number of miles towards the east into the state of New York and to an unknown distance westward into Canada. In this the waters have formed a chasm, gradually wearing

* This calculation is made by throwing a log into the water at lake Erie and allowing it to float down to the next village.

their way to the present place. To this retrograde motion of the cataract, persons who have lived for a number of years in its vicinity are able to attest, and the appearance of the whole, ground affords evident indications of the fact. Opportunity for examining the state of the precipice is furnished by a passage behind the falling sheet, which in its descent projects many yards beyond the ledge.

Some persons who concur in the opinion that the cataract originally commenced at Queenstown, declare it impossible that it should have proceeded so far in the time which has elapsed since the creation, according to the date assigned in the Mosaic accounts, and this is made an occasion for calling in question the authenticity of those records. But from the investigations of recent travellers it appears that no accurate calculation can be made of the progress of the operation, as the rock is not of uniform texture throughout the mass. In some places it is soft and crumbles off in peices; in others it is so firm as to be reduced but by slow degrees. The more solid parts will sometimes begin to yield rapidly from being deprived of support by the falling away of the surrounding portions. The decay is greater at some seasons than at others. In several instances very large masses have been detached at once.

The present distance of the falls below lake Erie is about eighteen miles. Over this ground they will sooner or later complete their course, and at last, the mound being entirely gone, the waters of lake Erie may be suddenly poured into lake Ontario. A deluge of the whole surrounding country would be the consequence. Many thousands of years at least, however, must elapse before this can happen, unless the process of decay becomes more rapid than at present.

4. *Volcanoes.* Sudden and extensive changes in the earth's surface are wrought by volcanic fires. Mountains of a great height have been thrown up in a short time; —islands have been formed almost instantaneously in the midst of the sea. Extensive tracts of country have swollen and burst open, throwing up numerous elevations.

The number of volcanoes or burning mountains which are known to exist is about two hundred. They are found in every part of the world. The most celebrated are those of Italy, Sicily and Iceland. All the volcanoes now in a state of activity are situated near the sea. This circumstance renders it probable that eruptions are caused by the occasional influx of the waters upon subterranean fires. The sudden retiring of the sea, which has been observed immediately before an eruption favors the supposition. The powerful effects of the sudden collision of fire and water may be inferred from the following instance. A bell of enormous size was ordered to be cast in one of the Italian cities. When all the usual preparations were made, the liquid metal was led into the mould, situated at a small depth under the pavement, through a narrow channel. No sooner had the burning fluid entered the mould than a dreadful explosion took place. A deep hole was sunk in the earth; the metal, the mould, and every material of the portico under which the works were prepared, was scattered in the air. Several persons were killed and others severely wounded. Such were the immediate consequences of the trifling degree of moisture remaining in the sand composing the mould. Hence may be inferred the effects of a vast body of water meeting with subterraneous fires. The fact that a quantity of water thrown upon an ordinary fire, produces no dangerous effects, may here present a difficulty. It should be understood that in the cases described, the violence of the action is occasioned by the struggle of the vapor for a vent, the weight of the superincumbent earth opposing its escape.

To the furious efforts of fire, hot air and vapor, are attributed those sudden and violent tremblings, denominated *Earthquakes.* When this accumulated matter can obtain a free passage as through the openings of volcanoes, the convulsions produced are comparatively slight; and in the neighborhood of volcanoes, shocks are observed to become less frequent after a violent explosion through the craters. The ruinous consequences to the lives and works of men, in numerous instances, resulting from volcanic operations are known to all. On the

striking alterations frequently produced in the aspect of countries we remarked at the commencement. It may be added that, of the whole number of islands upon the globe, the greater part are supposed of volcanic origin. One which has recently made its appearance in the Mediterranean, has attracted considerable attention.

CAVERNS.

Caves or caverns are openings or hollows in the solid crust of the earth. They are in a great measure peculiar to mountains and are seldom or never found in plains. They frequently occur in the Archipelago, Azores, Canaries and other islands because they are usually the tops of mountains and have been subject to volcanic action.

There are many and various causes for the formation of caverns. They may be produced by the same causes which occasion gulfs, apertures or sinkings in the earth. These causes are the explosions of volcanoes, the action of subterranean vapors and earthquakes, which create such commotions as must necessarily produce caverns, fissures and hollows of every kind. Caverns in limestone and gypsum are, unquestionably, the result of the dissolving power of water. The almost perfectly uniform direction, the gentle and equable declivity of most caves, which occur in these formations, appear to be the effect of the long continuance of water in them, the action of which has widened the existing crevices.

The *form* of caverns depends, partly upon the nature of the substance in which they are found, but it is frequently altered by external causes.

Many caves are remarkable only on account of their great extent, or sublime from the awful gloom, which pervades them, and the echoes which roll like thunder through their vaulted passages. Others are famed for the extreme beauty and magnificence of their stalactic figures and drapery, which when illuminated by torches, resemble

fairy halls of sparkling diamonds. From some poisonous vapors exhale; from others, valuable medicinal salts are obtained. Caverns were the primitive places of burial. In Kentucky and Tennessee, there are many which appear to have been used for that purpose. At the present day, they are in all civilized countries regarded simply as objects of curiosity.

In limestone rocks, the water trickles through the roof, dissolving a portion of the lime, and again deposits it when dropping. It thus gradually forms a slender tube, like an icicle, called a stalactite, of pure and brilliant whiteness.

In the progress of time, these stalactites are lengthened into large pillars, hanging from the roof. This class may be termed stalactic caves. The water which falls on the floor of these caverns makes a similar deposit, and forms a pedestal there, called a stalagmite, which often unites with a stalactite and completes a column. These columns are frequently enlarged to a great size, varied in their shape, and sometimes beautifully fluted. In some cases the parts are imperfect. A stalagmite rising from the floor seems like an altar or statue: or a number of stalactites depending from the roof are united into a curtain.

In this way the most interesting and fantastic forms are produced; and one of these cavities resembles an immense cathedral, lined with columns, or a magnificent palace in ruins.

The deposit which forms the stalactites and stalagmites, is capable of being highly polished and wrought into the most beautiful ornaments, and is usually called spar.

All the great calcareous formations, the mountain limestone as well as the more modern, are excavated in many directions into large vaults and fissures, several of which have long been admired on account of their sparry roofs and stalactite projections. In the limestone districts of England there is a great number of such vaults and subterranean rivers. In Derbyshire there are twentyeight remarkable caverns and as many open fissures, which are called locally swallow-holes, from their swallowing up the streams that cross the limestone districts of that country. The fissures descend from the surface to a very

considerable depth, and often expand into vaults or communicate laterally with caverns.

BONE CAVERNS OF GERMANY.

The bone caverns of Germany in limestone districts, have excited the deepest interest among geologists. Numerous grottoes, brilliantly decorated with crystalline stalactites of every form, succeed each other to a great extent throughout the body of the Hartz mountains. The openings between rooms of magnificent extent, are frequently so narrow that a man can hardly crawl through on his hands. Their floors are strewed with enormous heaps of the bones of animals of every size. These vaults of death are not peculiar to Germany, but are found in many places in far distant lands.

How these immense quantities of bones could have been accumulated in these vast caverns has been a most interesting inquiry to the ablest naturalists. Only three general causes can be imagined. 1st. They are either the remains of animals which have dwelt and died peaceably in these chambers; or 2d, of animals which inundations or other violent causes carried in; or 3d, of animals which had long been enveloped in stony strata, whose solution produced the caverns themselves, — the soft parts of the animals, being dissolved and carried away with the softer parts of the rocks in which they were imbedded.

If the last hypothesis were true, the bones would have been mixed with the surrounding materials of the mountains. And if they had been so mixed, they must have been coeval with the mountains themselves. The state of the bones clearly shows that their origin must have been comparatively recent.

The second hypothesis, that they are the bones of animals carried in by inundations or convulsions of the earth, is refuted by the entire state of preservation of the smallest prominences of bones, which could not have been the case, had there ever been friction between them.

We are, therefore, compelled to resume the first supposition, and to regard these caverns as the dens of Antediluvian *carnivora*, which dragged in thither and devoured animals and parts of animals, that fell in their way.

Of all the bone caverns of Germany the astonishing Gaylenreuth is most extensively known.

This cavern is in the Hartz mountains, southwest of Hanover in Germany. It has long been celebrated for its immense quantities and varieties of fossil bones. The entrance is seven and a half feet high, through a vertical rock, which faces the east. There are six rooms or grottoes succeeding one another, varying in size and connected sometimes by long narrow winding passages, and sometimes it is necessary to descend fifteen or twenty feet almost perpendicularly in order to visit the room beyond. The two largest rooms are about 80 feet in length. The floors of all the rooms are thickly covered with the bones of the wolf, fox, glutton, hyæna, bear and lion. The bones of the bear are more numerous than either of the other animals. Remains of the lion and of the hyæna are found principally in the last room. The opening was much too narrow for those animals to have entered by it. There must have been some other entrance, which is now closed, or else the present opening has, by some cause, been made smaller than it was originally. Bones of men, horses, oxen and sheep have been found in small quantities, but their state of preservation proves, very clearly, that they must have been deposited at a much later period than those of the bears, hyænas, &c.

WARE'S CAVE.

This cave is near the Shenandoah river in Virginia, and is so called from its discoverer, Burnet Ware, who first explored it in 1804.

The entrance is narrow and difficult, and when first discovered the passage was impeded by stalactites; these have been, however, removed. As a person advances into the cavern his course is first horizontal, then he descends 15 or 20 feet into a large echoing cavern. This is called Washington hall, and is about 270 feet in length, 35 in width and between 30 and 40 feet high. Stalactites of silvery whiteness are suspended from above, pillars of stalagmites are rising around, ledges of rocks from the floor, and the uneven walls are encrusted with a beautiful brown spar.

Passing through a narrow crevice twelve other apartments are found with as many creeping places between, differing in shape and size from the first, but resembling it in the irregularity of the walls, floor, covering and the calcareous concretions, which assuming fantastical shapes, displaying sparkling lustre, more vivid as the light grows stronger, gives to the grotto the power of charming every beholder.

The cave is a mile and a half in extent, and extremely irregular in course and shape. The height varied from 30 to 40 feet and the breadth from 20 to 30. Blue limestone is the ground work of this cavern. The apartments are everywhere covered with incrustations of hard carbonates; these hang from the arched vault above in clusters, and often reach the ground in massive columns. Stalagmites rise from the floor like statues. The irregular sides of the ledges of rocks have the appearance of banks of salt. The walk seems like a diamond pavement, and the foot-way round it of pebbles, which resembles the bed of a river which has deserted its channel. Water comes dripping down from the ends of the stalactites, the echoing sound of which is the only interruption to the profound silence which reigns in the cavern.

There is scarcely anything on earth to which these concretions may not be supposed to bear a resemblance; but yet they are unlike everything but themselves.

FORTIFICATIONS AND CAVE OF ST MICHAEL, GIBRALTAR.

The fortifications are excavations in the solid rock. They were commenced during the reign of Napoleon, and are designed to prevent all approach on the land side. The entrance is at an old Moorish castle, about four hundred feet above the level of the sea. The principal avenues are large enough for a carriage to pass through, and are several thousand feet in length. These ascend gradually to the northeast, but so gentle is the ascent, that a mule loaded with cannon balls easily makes his way to the farthest extremity. From these principal avenues, are cut lateral passages, terminating in small

chambers with post-holes, in which lie guns of the largest size ready for action.

Towards the southern extremity of the rock is St Michael's cave, 1000 feet above the level of the sea. The mouth of the cave is but five feet wide, but descending a slope, it opens into a spacious hall, apparently supported in the centre by a large stalactitical pillar. Succeeding this is a series of caves, but the passages are so narrow and intricate, as to render them hardly accessible. The whole of the cave appears like a darkened church destitute of galleries. This cave is thought by some to extend under the bed of the sea, to Apes hill on the opposite continent. This notion has its origin, in the frequent and mysterious appearance of African monkeys, which, as they have no other mode of reaching Gibraltar, are supposed to pass through the cave under the sea.

GROTTO OF CHERIBON.

At Cheribon, in China, is a grotto built by order of the Sultan. The grotto occupies more than an acre and a half. The entrance for a considerable distance, is ornamented with the most unnatural figures of men and beasts. Beyond this is a succession of grottoes, interior rooms and subterranean passages. Throughout the whole, are scattered pools of water, which reflect beautifully the objects around them. In one of the interior rooms is the bedstead of the Sultan. This was so placed that a current of water is conducted all around the top of the bed, which at pleasure might be permitted to fall in transparent curtains of rain, cooling the air in this sultry climate and forming a drapery of glittering showers.

THE CAVE OF SURTSHELLIR, IN ICELAND.

The cavern is pointed out by a heap of stones near the entrance. The entrance to the cavern is about forty feet in height, and fifty in breadth, which dimensions the cavern retains for more than two thirds of its extent, which has been ascertained to be 5,034 feet. There are but two passages to the cavern, one through a deep pool

of cold water, the other down a perpendicular wall thirty feet in height. After passing the main cavern, are two passages leading to a room which was inhabited by robbers in former times. Entering these passages, the progress of the traveller is arrested by a wall about three feet, evidently artificial. There is a small door in the middle, opening into a room about three hundred feet in extent and eighteen in height, and adorned with stalactites. Around the entrance to the room, are heaps of bones of various animals, which were killed by the robbers for their subsistence.

Passing through pools of water, and over broken pieces of lava, and along a slippery descending floor, the traveller arrives at a place which amply repays him for all his toils. It is a cavern, the roof and sides of which are decorated with crystallization of exquisite beauty; from the icy floor rise pillars of ice about four feet high, and two feet in thickness, generally pointed at the top. The crystallizations are of every possible form, some resembling objects in nature, others rivalling the finest works of art.

REMARKABLE CAVERN OF HOONGO.

On the island of Hoongo in the South Pacific Ocean, there is a very remarkable cavern situated on the western coast. The entrance into this cavern is beneath the surface of the sea even at low water. The depth of the entrance below the surface varies with the different heights of the tide. The nature of this cavern will be better understood if we imagine a hollow rock rising sixty feet or more above the surface of the water, into the cavity of which there is only one opening, and that opening on the side of the rock, several feet under the water, which flows into it, and consequently the base of the cavern may be said to be the sea itself. Mr Mariner, a gentleman who was a resident several years in the island, gives an interesting account of a visit to this cavern. One afternoon as he was walking towards the shore, he was greatly surprised at seeing some of the young chiefs, diving into the water one after the other and not appearing again. He hastily inquired of the last, as he was

preparing to follow his companions, what it meant, what they were about. 'Follow me,' said the young man, 'and I will carry you, where you never were before, and where Finnow (the king) and his chiefs are assembled.' Mr Mariner had entire confidence in him, and thinking it was undoubtedly the famous cavern, which he had long wished to explore, gladly prepared to accompany him. The young chief dived into the water, and guided by the light from his heels, Mr M. followed, entered the opening in the rock, and having dived through the passage several feet in length, rose into the cavern. He heard the voices of the king and his friends as soon as he rose above the surface of the water, and being directed by his guide, he climbed up a jutting portion of rock and sat down. It was not very dark—a little light was reflected from the bottom. After remaining there a few minutes, he could discover, directed by the voice, the rest of the company seated like himself around the side of the cavern. Wishing very much to examine it more thoroughly and with stronger light, Mr Mariner dived out again, obtained a pistol, some light combustibles and a torch, and wrapping them up so as to secure them from the water, returned to the cavern. He then lighted his torch and the place was illuminated for the first time, perhaps since its existence. It appeared to be about forty feet wide in the centre and branched off, on one side, into two narrower portions. The average height seemed to be about forty feet. The roof was hung with stalactites in a very curious manner, resembling upon a cursory view the gothic arches and ornaments of an old church. Mr M. wished to ascertain whether there was not some concealed opening in the cavern, by means of which fresh supplies of air were obtained, and for this purpose swam around the cave with a torch in his hand, but without discovering any. He also climbed to every accessible place with as little success. Another individual visited this cavern at low water. He felt a current of air and on examining for its source, found a hole about a foot in diameter, from which proceeded a steady breeze, but not the least glimmer of light. Through this hole there must have been some communication with the external

air. When Mr M. was there it was nearly high water, and the hole was probably covered, and if it were not, air could only enter when the tide was going out.

CAVE IN KENTUCKY.

The following account is contained in a letter from Dr Ward, who visited this cave in 1816.

The entrance to this cave is through a pit 40 feet deep; at the bottom of the pit is the passage into the cave, which is from 40 to 50 feet high and 30 wide. The road from the entrance to the chief area or city, is called the main avenue. This avenue is hard, and as smooth as a flag pavement; the walls of the cavern are perpendicular and the arches regular. The chief city is 6 miles from the entrance, and covers 8 acres. No pillars support the arch which is solid, and entire, being 100 feet high.

Five large avenues lead from this city; they are from 60 to 100 feet in width, and from 40 to 80 feet high. The walls are of stone, and arched. Dr Ward pursued his course along one of the avenues to the second city (which is 2 miles from the first) through which he passed into another avenue, from the walls of which, at the distance of 30 feet from the ground, a stream of water issued. Retracing his steps back to the chief city, after traversing the 5th avenue, he entered a vertical passage, just large enough to admit the body. At length he came into a chamber 1800 feet in circumference in which many curiosities were found as glauber and Epsom salts, flint, yellow ochre, spar and petrifactions.

There is a room in the caverns, called the 'Haunted Chamber,' from its echo; the passage leading to it is a branch of the main avenue, and has the arch beautifully encrusted with limestone and spar. Columns of this spar reach from the ceiling to the floor. In the centre of the arch is a dome 50 feet high, it is hung with rich drapery, and festooned in the most fanciful manner 6 or 8 feet from the hangings; the colors are rich and brilliant. On the left side of this chamber is an entrance to a narrow defile which winds beneath it. The air in this passage is pure and delightful, as it is in all parts of the cav-

ern. At the farther part of this avenue is a reservoir of water very clear, and delightful to the taste; it apparently has neither inlet or outlet.

At a little distance from the reservoir of water were columns of spar 60 or 70 feet high, and nearly perpendicular, standing in basins of water, that comes trickling down their sides, then passes silently from the basins and enters the cavities of stone, not to be seen again.

Dr Ward then returned through the winding into the 'Haunted Chamber' to the main avenue, and then departed from the cavern. On coming out of the cavern he found some difficulty in breathing, for the air below was extremely pure on account of the nitre.

CAVERN OF THE GUARACHARO.

There is near the valley of Caripe, which is in the northern part of Caraccas, a remarkable cave, called *the cavern of the Guaracharo*, which the natives call a *mine of fat.* It is about 400 steps from the foot of the lofty mountain of the Guacharo, yet a person standing there, cannot perceive its entrance. The path leading to it is so winding, that its immense opening cannot be seen until you reach the last turning, when it bursts suddenly upon the sight.

With respect to the splendor of its stalactites &c, it resembles other caverns, but it is also adorned with plants and flowers. Its entrance is in the side of a rock, and upon approaching it, plants may be seen at the distance of 30 or 40 paces from the mouth, where the rays of the sun can never penetrate. The aperture is 30 feet broad and 72 feet high. The part of the rock which is over the cave is covered with lofty trees, and among them may be seen a beautiful violet-blue bignonia.

This cave is inhabited by thousands of nocturnal birds called guacheroo, they are about the size of our common fowls, with crooked beaks, surrounded with stiff silken hair. They come out of the cave in the evening, especially when the moon shines, to obtain fruits upon which they subsist. Their plumage is of a dark bluish gray, mixed with small streaks of black. The head,

wings and tail, are marked with white spots in the form of a heart and bordered with black; the eyes are blue.

The cavern preserves the same direction, breadth and height for the distance of 1458 feet. Daylight is sufficient to guide an individual through the distance of 430 feet, when it becomes necessary to light torches. Where day-light begins to fail the hoarse sound of the birds can just be heard. Their cries are shrill and piercing. The Indians who accompany visitors into the cave show them the nests of the birds, which are 55 or 60 feet high, by fixing lighted torches at the end of a long pole. These nests are in the shape of funnels.

The Indians enter the cave once a year, at mid-summer, and destroy most of the nests and kill thousands of birds. The young ones are immediately opened, who furnish a large quantity of fat, which is known by the name of the butter or oil of the guacheroo. They are superstitious and unwilling to go to a great distance into the cave. The stalactites descend from the top of the vault and resemble columns suspended in the air.

The length of the cave has not been exactly ascertained. One individual went to the distance of nearly 2500 feet from the mouth and found that it extended farther.

DESCRIPTION OF THE GROTTO AT SWATARA, PA.

There is a grotto situated at the east side of the Swatara about two miles from the Susquehanna. Its entrance is very spacious. The upper part is an arched roof, of solid limestone, about 20 feet thick. There are many apartments in the cave, some of them very high. The water is continually dropping from the roof upon the floor, which petrifies as it falls, and gradually forms pillars to support the roof. More than thirty years ago there were ten such pillars each six inches in diameter and six feet high.

There is in one part of the cave a piece of stone issuing from the roof, which when struck sounds like a bell, and therefore has received the name of the bell.

Some of the stalactites are of the color of sugar-candy and others resemble loaf-sugar.

The cave descends a little towards the farther end, and the water as it falls from the roof runs down the declivity, and when purified, it is wholesome and pleasant to drink. There are several holes in the bottom of the cave which descend perpendicularly into an abyss.

At the end of the cave is a pretty rivulet, which runs through a part of it and is then lost among the rocks.

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SCIENTIFIC TRACTS.

VOL. II......NO. XI.

I. SELF-EDUCATION OF BUSINESS MEN.
II. MANUSCRIPT MAPS.

As it is the design of our series of Tracts, to diffuse useful knowledge throughout the community, we have thought it best to devote a number to the subject above expressed. There are probably a great number among our readers, who, though engaged in active business, are still deeply interested in their intellectual progress, and who will consequently read with advantage an essay on the means by which this progress may be secured.

The writer of these pages was once, when quite young, at the house of an aged gentleman, who was one of the principal inhabitants of an important town in one of the New England States. The property he had acquired,—his character for strict integrity,—and the fund of information which he possessed, and which rendered his conversation at all times highly interesting and useful, had all conspired to give him a very high standing in the community. This gentleman one day remarked to a friend, when conversing on the great interest felt in schools at the present day,—that he himself never had opportunity to attend school but three months in his life.

'But three months!' was the reply. 'How could you learn to read, write, and cipher in that time?'

'I learned but very little in that time. I learned to read chiefly before I went there, of my parents, at home,—and carried on my arithmetic myself after I left school. I well remember,' said he, 'that I had no slate. I ob-

tained, therefore, a large shingle and a piece of chalk, which I kept under the bench of the shoemaker's shop where I worked, and during the intervals of labor I wrought out my sums.'

His account stopped here, but it may be added that the same strong desire for mental progress continued with him through life. The man educated himself. His life was a very active one as to business, but he always found time for self-culture, and at the age of seventy, few of his contemporaries would surpass him in intellectual power. A few weeks before the conversation given above, he was reading with intense interest the pages of Ferguson's Lectures on Astronomy, and entering into it with all the spirit of twentyfive.

But the reader will perhaps say, 'All this is nothing extraordinary. I know of a dozen just such cases.' We know it is nothing extraordinary. Such cases are common, and it is on this very account that one is brought forward, because the very fact that such success is common proves that it is easy, if the heart is bent upon it. This tract will be read by some thousands of young men, just setting out in life, nearly all of whose future cultivation must necessarily be self-cultivation. We bring forward this example to interest and influence them, and for this purpose we do not select some rare and solitary instance of the flight of genius to tantalize them with an example, which they cannot imitate. We take a specimen which is common. Hundreds of different individuals in various parts of the country, will probably be brought by our description to the minds of our readers, — and this very commonness is what we rely upon as giving our illustration all its force.

The effect of knowledge in a man of business is twofold, to enable him to work more profitably — and to spend his life more happily. The former of these effects was very well illustrated the other day by a conversation between a gentleman and an ignorant black boy, who was employed to run of errands. As our tracts are read by boys as well as men, it may be well to relate it.

'John,' said the gentleman, 'can you read writing?'

'No, sir,' said John.

'I am sorry for that,' said he, 'for here are two letters to go to different places, and I am afraid you will mistake, if you cannot read the directions.'

John said, he would hold one in one hand and the other in the other, and that he would try not to make a mistake.

'Well,' said the gentleman, 'I want you to take this one to Carter & Hendee's, the booksellers, in Washington Street. Do you know where it is?'

'No, sir.'

'It is near the foot of School Street; you will see the sign on the door.'

'I can't read the signs very well, sir.'

'Can't read the signs! what shall we do?'

John said he could inquire. So he took the letters and walked along, holding them in his two hands, and trying all the way to remember whether he was to leave the one in the right or in the left hand, at the bookseller's.

When he returned the gentleman said to him as follows:

'Now, John, you know how much better you could do my business, if you could read and write. The last boy I had kept accounts for me. I gave him two or three dollars, and whenever he had to pay anything for me, he paid it from that fund. He also paid himself at the end of the week, and then presented me with a regular account. This saved me a great deal of trouble. Besides, when I had various notes and letters to send away, I put them into a little place over my desk; he would go there and get them and distribute them all over the city, without asking me any questions. But until you learn to read and write, you cannot do this. I can only give you as many parcels as you have hands,—and I must make the exact change every time I wish you to pay away any money for me. Your services, therefore, are worth only about half what they would be, if you would learn to read and write. Now if you are willing to learn, I will give you a lesson every day, and double your wages as soon as you have learned, which will be in a month or two.'

John listened very attentively, but he thought on the whole he should rather play than spend his time in studying.

Now the effect of knowledge in enabling its possessor to make his business more profitable to himself and others is not confined to such a simple case as this. The principle applies in all cases. The more an individual knows on subjects connected with his business, the more advantageously he can work, and of course the avails of his labors will be worth more. One carpenter learns his trade thoroughly and is contented with a mere manual skill in his business. Another, while he goes on industriously in his daily work, spends his leisure time in studying the principles of geometry, in examining books on the strength of materials — the quality of timber, — forms and principles of domes and arches, — and in process of time he is employed in such works as planning and constructing bridges, churches, and great public edifices, and every one knows how much better paid are such labors, than the ordinary work of a journeyman.

In order to place this subject in its true light, we must consider by what means money is earned. The elements are three, *Labor*, *Capital* and *Skill*.

1. *Labor*. A hundred Irishmen are employed in excavations for a canal. They bring no tools and they need no skill. It is mere *labor* that they bring — simple muscular force. The only object is to take a mass of earth, which is now in one place and remove it to another a few yards distant. They are paid, therefore, for mere physical force, and receive the smallest compensation which human effort procures.

There are in Europe immense multitudes of men laborers. They have nothing with which they can benefit the community but their bodily strength, and this strength must of course be directed by the skill of others. There are in this country very few mere laborers, and their compensation is of course small. They will perhaps under favorable circumstances receive $300 a year.

2. *Capital*. There are various things which men work *with*, so as to work to greater advantage. They benefit their employers more and are consequently better paid. This can be illustrated in various ways.

A stage-driver, who by his industry and frugality, has laid up a little money, purchases a coach and a team

of horses, and runs a stage himself from one town to another. He defrays all the expenses and takes all the receipts, and if his plan was judiciously laid, and if the business is properly managed, his income will be vastly more than it was when he was driving upon monthly wages. He works with capital. His coach and his team are his instruments, with which he makes his labors vastly more serviceable to the community, and consequently he is better paid.

In the same manner, the merchant, who owns a ship, works with capital, and if he plans judiciously, clears in the year vastly more than the mere laborer, who receives but his three hundred dollars. It is not because he does more work, or works harder, but simply because he has something *to work with.*

The most extensive class of capitalists in this country are the farmers. The young man who begins the world by working for his neighbors, at twelve or fifteen dollars a month — making hay or ploughing land, — is paid for simple labor, and will earn, including board, perhaps $300 per year, as stated above. But after a time he comes into possession of a small farm. Now he has something to work with, and he earns in the year a very much greater sum. As his property increases, he adds to his capital. His yoke of oxen, his plough, his horses, his tools are all capital, and they give greater and greater efficiency to his labors, until at last he becomes a wealthy farmer. The time he spends in labor is gradually diminished, yet such is the power of capital that his yearly income increases.

The handcart of the porter is his capital, and by it he can earn more money than by simple labor. The tools of the journeyman carpenter are his capital; the saw and axe and sawhorse of the woodcutter, the stock of the trader, the apparatus of the lecturer, and in fact property of every form, which is made the means of rendering more available the efforts of the possessor, — is capital, — and it doubles, trebles and sometimes increases a hundred fold, the results of labor.

3. *Skill.* The profitable results of labor are very much increased by uniting it with knowledge or *skill* as well

as with capital. And it is this part of the subject with which we are now particularly concerned. A man who has learned a trade, will command a much higher rate of wages, than the ignorant man, who has nothing but strength to bring to the assistance of his employer. The greater the knowledge and skill, the greater the value of his labors and of course the greater is his pay. A young farmer who is employed simply as a laborer, spends, we will suppose, his winter evenings in studying books on surveying. He acquires knowledge and skill in this branch and is soon employed occasionally to *survey* the lands he before only *tilled*. He is immediately paid better. By working one afternoon in taking his measurements and one evening in plotting his survey, he will earn four times as much as he would by simply hoeing rows of corn. For in the latter case he must be paid for his labor only, but in the former for his skill and labor too.

The advantage, however, of acquiring knowledge and skill does not stop with the results of merely learning to survey a field. If he goes on with his inquiries, and becomes a first rate engineer, the value of his labors will increase, not exactly in proportion to the progress, but actually faster than his progress. The farther he goes, the more rapidly will his pay increase, so that he who began with $300 a year as a laborer may end with $2000 as the engineer of a rail-road or canal.

When we see how ready a market skill finds, and how much higher a price it brings than mere labor, it is surprising that men do not take greater pains to acquire it, and to go on acquiring it more and more through life. In a manufactory, one hand will earn nearly twice as much as another at the same loom, and all owing to a difference of *skill*. The same difference exists among the compositors in a printing office, clerks in counting rooms, and teachers in schools, and in fact in every employment where skill is combined with labor.

Where the skill or knowledge is very great, the effect in increasing the reward of the person who employs it is equally great. The man who has a knowledge of accounts and a systematic well-regulated mind, will man-

age a large establishment and make his fortune by it, while an ignorant or irregular man will soon throw everything into confusion and ruin himself and all connected with him. A physician with the skill he has acquired will come into your family and earn five dollars in as many visits, by saving the life of your child. He does not spend two hours in the whole time, but he richly earns his pay. Is not your child's life worth five dollars? And yet during this time the mere laborer will not earn fifty cents.

A lecturer purchases some apparatus, and by his knowledge of some scientific subject, or his happy mode of communicating his knowledge, he entertains four hundred people in a public lecture-room one evening, for which, after all expenses are paid, he receives fifty or seventyfive dollars. Here is *knowledge* or *skill* (for though there is an obvious distinction between them, they are of the same general nature, and may be classed together), and *capital*, and *labor* all combined. The man works no harder than the wood-sawyer, who is all the evening working at the door of the lecture-room. But the wood-sawyer has not the capital or the skill,—and he goes home consequently, happy if he receives as many cents as the lecturer does dollars.

Young men, who are beginning the world, do not think enough that knowledge or skill, as well as time, is money. They might, by spending one or two hours every day in intellectual pursuits, especially in those connected with their business, in a very short time very materially increase their power of earning money. Suppose in order to do this, or to get the means of doing it, they lose a little time for present work,—or expend a little of their present earnings, they will far more than compensate for it in the end. If I had a slave he should not spend all his day in labor. On the simple principle of realizing from him all that I could, I would require him to spend an hour or two each day in acquiring knowledge or skill, so as to render his future labors more valuable. He should learn to read and write. He should study book-keeping, that he might be my clerk, or learn a trade. If I kept him a mere laborer, I should be employing him all his

life in the very way which is of all others the least productive.

All these three elements of productiveness, namely, labor, capital and skill, are usually combined in the business of life. The carpenter labors,— his tools are his *capital* and his trade is his *skill.* The physician has little or no capital, and performs but little labor; his income comes almost entirely from his skill. The merchant depends chiefly on his capital; still his whole time is employed in personal effort, and he must have some skill. In some cases, capital alone is employed. Two partners, one rich, the other wise, engage in business. The one furnishes money, the other manages the business, and they share the profits,—one being paid for his capital, the other for his labor and skill.

It is of the highest importance, however, that it should be *true* knowledge and skill, that the man of business endeavors to acquire in order to derive benefit from it. Suppose a mechanic were to neglect his regular business, and spend all his time in reading various books and in fruitless and expensive attempts to invent some wonderful machine, or perpetual motion,—and call it an endeavor to earn money by his skill;—this would not be knowledge, and skill,— it would be folly. It is ignorance—sheer ignorance of the true sources of prosperity in the world. The true application of knowledge and skill is to perfect the ordinary and regular business of society, not to endeavor to discover some new by-path to fortune. The man should study to improve his business—examine subjects connected with it,—learn how to arrange his engagements so as to avoid collision and friction—systematize his mind—look forward to the higher branches of his business,—for what business has not its higher branches? and thus go steadily forward till he can bring more and more capital, and more and more skill into requisition, taking care to keep everything well regulated, and to carry on his business in the most systematic manner. This is the way to bring additional skill and knowledge to his work.

The second reason why every man should go stead-

ily forward in the cultivation of his intellectual powers is, that progress in knowledge makes life pass more pleasantly. After all that is said about the shortness of life, sixty or seventy years is a long time, and it is of immense consequence that these years glide away happily. Now, progress in knowledge and the consciousness of intelligence which results from it, is one of the purest and noblest sources of enjoyment. A desire to know, is one of the first and strongest feelings manifested in infancy. The child is eagerly and intently at work examining all things within its reach, to see how they are put together, and often how they will come to pieces. Why does it take pleasure in striking a stick upon the floor? It is not because the mere effect of the sound upon the ear is agreeable, — if it were that, sound would be like the taste of sugar, always pleasant. No: he is learning the nature of sound — he observes the cause of it — is pleased to witness his own power to produce effect, — and when all these and similar thoughts, by which he is regarding it as a philosophical phenomenon, are become familiar, he throws the stick away and searches for something else. He goes about the room seeking for some other way in which he can produce effect. The solid table resists his efforts and he leaves it. The door he can swing and that pleases him. He can tear the leaves out of a book and is delighted; he throws down a cup and breaks it into atoms, and is in ecstasy. The greater the effect he produces, the more vivid his lesson — the more brilliant the experiment. Children always delight in destruction. They are not to blame for it before they know the value of what they destroy, — their simple motive is desire of *seeing effects*, and destruction is the only effect they can produce.

Look at a toy shop. Every article is extended to show the child something about form or color or motion or noise. A toy which would not give a lesson on some such subject, a child would despise. So that his basket of playthings is seriously and soberly a collection of philosophical apparatus, differing from the splendid cabinet at Harvard University only in its teaching simpler lessons.

Let us now go to the other extreme. That is, let us see whether the pleasure of acquiring knowledge continues after great acquisitions have been made. Does it *continue?* It goes on increasing and strengthening the farther the powers expand. A botanist who has examined all the plants of his own cultivated and civilized land, will abandon home and friends and wander into remote and savage wilds, to sleep by night with the tomahawking Indian, and walk by day within the reach of the serpent and the tiger. And why? — Why, because it is so delightful to him to explore nature, when he has studied her enough to understand her. It is not that his mind is constituted differently from ours, so that what pleases him would not please us, — it is because he *knows more;* and if we had made his progress in knowledge we should wander with the same delight along the sides of the Rocky Mountains or upon the shores of the Lakes.

A Greek scholar will acquire such a fondness for the study of that language, and will become so absorbed in the scenes to which it will introduce him, as to lose all relish for a thousand enjoyments which he loved before. Great scholars are proverbially absent-minded. That is, they become so interested in their studies, that they lose an interest in what takes place around them. This, though it is by no means an example to be imitated, shows that the human mind is formed, so as to take a constantly increasing pleasure in progress in knowledge. This pleasure rewards progress in knowledge in every stage and in every degree. The man of business, who, while he pursues with diligence and regularity his appropriate pursuits, still makes constant progress in knowledge, will lead a vastly more happy life than if he merely goes through his daily routine, and advances from year to year no wiser, and no more elevated in intellectual character at fifty than he was at twentyone.

But what are the means of intellectual culture within the reach of men especially of young men, engaged in the active business of life. I shall briefly describe such as occur to me.

1. *Club for procuring books.* There are now constantly issuing from the press, works of various kinds,

containing useful knowledge for practical men, which it is not necessary to own. The plan has been often adopted of forming clubs to procure these in the following manner. Let a half a dozen or a dozen gentlemen unite and each contribute a sum sufficient when united to procure several of these books, which are to be circulated under suitable regulations, among the members. When all have read them, they are to be sold, perhaps for half price, and other books purchased; a small additional contribution making up the deficit. The writer of this tract once belonged to a club of this kind by which new books were procured, just as they were wanted, at a very small price. It is true we only had the reading of them, unless any member wished to own a particular book, and then he had the liberty of taking it after it had been circulated in the club, at the price which it would have procured, when finaly sold.

There is an association of literary gentlemen in Boston, who unite to procure the new and valuable works which are issued from the press abroad, and a vast amount of information, which would be otherwise inaccessible, is thus circulated among the members. To secure regularity in the operation of the plan the regulations are printed and a copy is attached to each volume, as it circulates.

2. *Circulation of Newspapers and other Periodicals.* This country is remarkable for no peculiarity more than for the influence of its periodical press upon the whole mass of the community. Paris and London feel, it is true, the power of the press, but there is a vastly greater proportion of an English or French than of an American population, to which the columns of a newspaper never speak. The press in this country too is employed not merely in disseminating a knowledge of the mere passing events of the day, but in diffusing valuable information of a permanent character. Periodicals devoted to the Arts and Sciences are within the reach of every one, certainly by the aid of such clubs as have been already described. The influence of a weekly or monthly visiter from the press, in awakening in a family a taste for knowledge, and for domestic, fireside enjoyments, any one may easily appreciate.

The Lyceum. The rapidity with which this plan has spread, and the happy results which have generally flowed from it, show how well adapted it is to the condition of man as a social and intellectual being, and to the institutions and habits of our country It would be interesting to go fully into this topic, for the purpose of showing by what means this institution may be made most successful in accomplishing its objects, but we must reserve this subject for a separate discussion.

Study. The principal means of improvement, however, which I shall mention, and it is one which is accessible to all, is severe, solitary study. A great many persons imagine that all which they have to do in order to go forward efficiently in intellectual improvement is to read, and hear Lectures, and talk of science. But no. Any man who understands the subject will say, that but few real and valuable attainments are to be made without *study*, in the strict and proper sense of that term. I know a young man, engaged in an active and laborious employment, which left him, however, his evenings, who resolved to appropriate a portion of his time to mental culture. He had no teacher, and he anticipated difficulties, but he was resolved to make the effort. He procured Day's Mathematics,—a book admirably adapted for this purpose, and began to study the subject of Logarithms and Trigonometry and Mensuration, as there explained. He devoted a short time each evening to his work,—and though his progress was slow, it was sure. He lodged in a small room near a street, in a large village, and when upon the subject of mensuration of distances, he undertook, in a way which is familiar to all mathematicans, to measure the width of the street, without leaving his room. He accordingly took his two stations at the two windows,—measured his angles and his base, and went through his calculations. I heard him say, that after he obtained his result, he waited with great impatience, until evening was so far advanced that the footsteps in the street were still, that he might go out unperceived and verify his calculations by measurement, and that his delight was extreme at finding that he calculated within a few inches of the correct result.

When he was upon surveying, he made a survey of the streets of his town, by pacing them as he went to and from his place of business, doing it with a careless air that he might not attract observation, and noticing the direction of each by means of a little magnetic needle in a watch key. His plan was not probably very accurate, but he fixed the principles indelibly in his mind by giving his knowledge immediately such a practical application. When studying navigation, he borrowed a sextant of a sea captain of his acquaintance, who also explained its use; and thus without any advantages but what are fully within the reach of all, he went successfully forward. Every man may do the same.

But what shall a young man do without a teacher when he comes to something which he cannot understand? He may take this course. Suppose he undertakes to study book-keeping. He gets his treatise and is ready to begin. Now if he undertakes to read the book as he would a volume of travels, he will certainly be plunged in difficulty. He must expect to study it, and for this purpose he must mark off to himself a small portion which he is to examine for his first exercise. He must read it carefully, sentence by sentence. He must often look back to compare each statement with the one preceding. When he finishes a paragraph, he must look back, and examine it as a whole,—take in as it were the whole meaning of it at one glance of his eye. Notice what there is in it that is new, and if there is anything which he does not fully comprehend, note it. Either make a memorandum of it or keep it in mind, so that if any future passage throws any light upon it, he may derive the benefit of it. Above all let him perform every written exercise required, and make himself familiar with every new term, and revolve again and again every new idea. If he has a child, or if there is a young person within his reach, let him explain the subject to him as fast as he acquires a knowledge of it himself, and if he has not such an opportunity, let him write all that he can recollect or understand of his exercise, in a note-book, kept for that purpose. This is study, in contradistinction from mere reading, and it is an exercise so well calculated to elevate

and strengthen the intellectual powers, that every young man who intends to rise among his fellow-men, ought to have the influence of it almost daily. You may gather a superficial acquaintance with many interesting subjects without it. But you will walk with crutches. You can never go alone, intellectually, till you can learn by books, — without a living teacher by your side.

This is the way that professed scholars apply their minds, and by practice they acquire such a facility of obtaining knowledge from books that they will understand any new science, learn a new language, or conquer any new method in mathematics with astonishing facility. It is said that the publishers of an Encyclopedia came to a distinguished lawyer who was known as a popular writer, and offered him fifty guineas if he would write the article on Chemistry for their work. 'I know nothing of chemistry,' replied the lawyer. 'I never attended to the subject an hour in my life, but I will write the article, if you will send me the best books on Chemistry.' They sent him the books. He *studied* them, and produced a most able and excellent article.

But we must close our remarks on this interesting subject. The field is boundless, but we trust we have said enough to interest some of our readers at least in the work of making regular and systematic efforts to promote their intellectual progress. And we will in conclusion, simply remark, that these minds which Providence has given us, are to go on increasing in their powers forever. The work then of making intellectual improvement is not a temporary one which the lapse of a few years will obliterate or destroy. It is eternal; — the commencement of a progress which has no end.

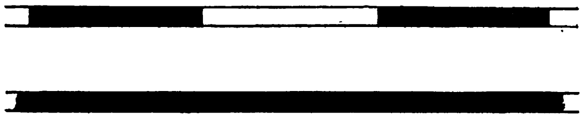
MAPS FOR LYCEUMS AND SCHOOLS.

There is a method of making large manuscript maps for use in lectures and recitations for literary institutions of every kind, which we have thought might be generally useful, if generally known. They are drawn upon cotton cloth, a material much superior to paper, both in respect to cheapness and durability. They were first, we believe, made by a lady to illustrate sacred geography for bible classes, but we havé since known them made by different individuals, for various purposes in schools and colleges. The style and manner in which the maps are executed, make them admirably adapted to convey clear and distinct ideas of the features of the countries represented, and as séveral teachers have inquired very particularly into the method of making them, we have thought that a detailed description might not be useless.

Material. It is of cotton shirting or sheeting, such as can now be purchased for from 17 to 20 cents per yard. The size which is generally used is about 1 yard by 1½ yds. If a much larger map is wanted, it is necessary to piece it, which may be done by a neat seam through the middle. The cloth is to be prepared for use by starching it with a thin starch, in which a moderate quantity of American isinglass is dissolved, perhaps about an ounce of isinglass to the square yard. It is then to be ironed, on an ironing board *as long as the cloth,* and rolled up as fast as it is smoothed. Some skill is required to avoid stretching the cloth in different places, so as to prevent its hanging in a plane. If the edges are stretched they will wrinkle, if the middle it will swell.

Drawing the Parallels, &c. As soon as the stuff is prepared, the border is to be drawn, divided and *numbered,* just as it is to be when the map is finished. The lines may be ruled with ink; — double, and about one eighth of an inch apart, and the space filled with India

ink, laid on with a brush. The whole making a double border as follows.

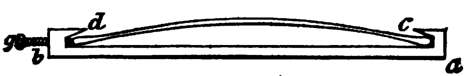


If the teacher chooses a more rapid mode, the black lines may be drawn at once with a pen made with a broad nib, as represented in the adjoining cut, (*a*). They should be as broad as in the above cut, as the map is to be seen from across a room. The parallels of latitude and the meridians, are also to be drawn much blacker than is usual.*

Delineating. The next step is to delineate the coasts, rivers, boundaries, &c, with a pencil, which may be done upon the smooth surface of the cotton, almost as easily and as accurately as upon paper. It ought to be remarked that the cloth, during the whole operation, must be kept upon a table, or a board *as long as itself*, and the part not in use is to be kept rolled up. If a board is used it may be laid upon a common table. If this direction is not adhered to, the ends of the cloth will hang down and become tumbled. Any errors in the delineation may be rectified with India rubber, as upon paper.

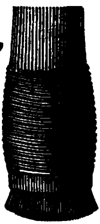
Shading the Coast. In doing this it must be kept in

* The following figure represents the best instrument we have



seen for drawing curved lines. It was contrived by Prof. Snell of Amherst College. and has never before been made public. We presume that gentleman would not object to our introducing it in this connexion. The part *a b* is a stiff bar of wood, four feet long; *c d* a slender rule, flexible, which is bent by turning the screw at *g* which presses upon the end. The rule *c d* should be thinner towards the ends than in the middle.

mind that delicate and beautiful work, for close inspection, is not our object, but strong and bold features, to strike the eye at a distance. The coast is to be shaded with India ink, rubbed very thick and almost dry. This is to be laid on with what is called a scrubbing brush,



b

that is, a brush cut off square, and close to the quill, as represented in the annexed cut. A brush of the size represented is best. It should be a common *camel's hair* pencil, not one of those used for painting on velvet. If one of this size is not at hand, an ordinary one, of the largest size sold in the shops, will answer, though it will require much more time.

The color must be laid on deep near the coast, and worked off lighter and lighter toward the water, as in common maps. After a little practice this can be done with great rapidity and uniformity. The shading should be two inches in breadth.

Coloring the Countries. The colors to be used should be rubbed in saucers, and diluted with water, until there are *two or three table spoonfuls* of each. The colors should be rather pale. They are to be laid on with a large brush, like *b*, above, only not cut. The work should be done boldly and freely, only as the colors sometimes spread a little, it is best to avoid coming out at first quite to the boundary. The color will itself extend a little way to meet it, and if necessary the work can be afterwards finished out by a small brush.

Putting in the ink strokes. After the coasts are shaded, and the countries colored, the rivers and boundaries, the roads, towns and cities, and everything else, which it is desirable to represent, should be drawn. The lines should be very deep and black, so as to strike the eye at a distance. A correct judgment may be formed in regard to this particular, by going to a distance from the work and noticing the effect. The distance should be at least twenty or thirty feet. The rivers should increase in blackness as they approach the sea; the mountains should be made to imitate those upon common maps, which with a very little practice, will be easy. Deserts, rocks,

canals and all other objects, representations of which will add to the beauty and utility of the map, can easily be added.

Printing. In most cases, maps of this kind are left *without names.* The purpose for which they are intended does not require them. The teacher can point to the places to which he wishes to turn the attention of the pupil, and in recitations in Geography, the names would be an inconvenience. In some cases, however, it is desirable to finish the map as usual, with the names of the countries, cities, &c. This can easily be done.

The printing may be executed slowly and imperfectly by a pen, but it is altogether better to use types. For this purpose an alphabet or two of large sized letters, both Capital and small letters, may be purchased for a trifling sum at a printer's. A little printer's ink should also be procured, and a small printer's ball, an inch in diameter, manufactured. With this, the ink can, by any person, be applied to the types, one by one, and then transferred to the map. Types for letters of the largest size will be more expensive, on account of the weight of the metal. Instead of them, *theorems*, as they are called, may be made, by cutting out from pieces of drawing paper, an inch square, the forms of the large letters. They may be copied from the heading of a newspaper. If these are now laid down upon the map, and a brush cut short, as before described and filled with printer's ink, is rubbed over it, the form of the letter will be very beautifully traced upon the map. The fine angles of the letters will, however, in this case, need a little finishing with the brush or pen.

Mounting the Maps. These maps may be executed rapidly and coarsely, and then folded when they are to be laid aside. They may be attached, many together, to one roller, and any one of the set may be displayed at a time. They may be mounted on separate rollers, in the ordinary mode. Or if the map is very large, it may be attached to a roller at the top, which moves on pivots and is turned by a string, so that the map may be drawn up and let down at pleasure, in the manner in which a species of curtain is often suspended at the present day.

Uses of these Maps. 1. For Lyceums. A lecturer before a Lyceum, when he has a historical or geographical subject, will find very great assistance from a map of this kind. In every Lyceum, there are ladies who would cheerfully prepare one, under his direction. It may be a copy of one already before him, or a compilation from several. The names, in this case, are not necessary. His lecture will supply them. If this method of preparing maps should be generally understood, it would be the means of introducing to attention, a large class of most interesting subjects, now generally neglected.

2. For Bible Classes. One country, Palestine, has already been illustrated by an *engraved* map, which has been extensively used in Bible classes, and sabbath schools. There are however other fields; the wanderings of the Israelites,—the countries visited by Paul, &c,—for which the teacher must depend at present upon his own ingenuity. Some pastors have had maps of this kind executed under their direction, by ladies who were interested in the purpose for which they were intended.

3. Literary Institutions. It is scarcely necessary to make a remark under this head. The advantages of large maps, to be placed in view of the whole class, in Colleges and Schools must be obvious. If the names are omitted, and the *places* only of the cities and towns marked, they may be used most profitably in schools for recitations in Geography;—the teacher pointing, while he asks the question, to the map before him.

AGENTS

FOR THE

SCIENTIFIC TRACTS.

MAINE.	
Portland,	*Samuel Colman.*
Hallowell,	*C. Spaulding.*
Augusta,	*Brinsmade & Dale.*
Bangor,	*B. Nourse.*
Belfast,	*N. P. Hawes.*
Eastport,	*H. S. Favor,* *B. Folsom.*
Norway,	*Asa Barton.*
NEW HAMPSHIRE.	
Dover,	*Edmund I. Lane,* *S. C. Stevens.*
Hanover,	*Thomas Mann.*
Concord,	*Horatio Hill & Co.*
Keene,	*George Tilden.*
Portsmouth,	*John W. Shepard,*
VERMONT.	
Burlington,	*C. Goodrich.*
Brattleboro',	*Geo. H. Peck.*
Windsor,	*Simeon Ide.*
Montpelier,	*J. S. Walton.*
Bellows Falls,	*James I. Cutler & Co.*
Rutland,	*Hawkes & White.*
Middlebury,	*Jonathan Hagar.*
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SCIENTIFIC TRACTS.

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TEMPERAMENTS.

THE study of Anatomy, or the doctrine of the structure of the human body, is in itself alone exceedingly interesting; the curious formation of the various parts of the system excites our astonishment, and we are struck with admiration of the Cause that contrived and arranged this wonderful, complicated machine. Nor are the operations performed by the different members, whether involuntarily or at our will, less subtle or intricate; but when we consider the thinking part, the immaterial mind which animates us, we are fixed in amazement. Not because its operations are unknown, but that such a principle should exist within us, and should have the power of acting upon our body, and that our body should be able to influence that.

The ancients observed that to certain appearances of the corporeal system, particular qualities of mind invariably corresponded: these appearances they named temperaments. Modern anatomists and physiologists have not only confirmed the ancient doctrines on this head, but have shown that those outward bodily qualities depend on peculiar formations and actions of the great organs of the interior. Among the moderns, Haller, Hallé and Richerand are among the celebrated men who have considered this subject: but of all others, the senator Cabanis in his celebrated treatise on the relations between the mind and body of man,* has accumulated the greatest number of facts. His extensive practice as a

* Cabanis. Rapports du Physique et du Moral de l'homme

physician and surgeon, the philosophical eye with which he viewed the operations of nature, and his great care not to admit any fact but what his own observation had shown to be true, render this work truly invaluable.

The moderns call temperaments the great physical differences in mankind, which have been found from time immemorial to correspond to certain peculiarities of the intellectual faculties.

Between the mind and body there is a very close union: most persons have observed instances of this connexion, such as that derangement in some of the bodily functions produces derangements of mind; that debility of body causes debility of mind; and in fact we all judge of a person's mental faculties from his physical attributes, and say that he is good, bad, intelligent or stupid, more from his general appearance than from any experience of his qualities. But though particular powers of intellect almost uniformly correspond to certain peculiar dispositions of body, to the predominance in size or action of certain systems of organs, people in general have but very indistinct notions of this truth.

As we shall have occasion in treating of the temperaments to speak of the various portions of the body (particularly of the great organs; those in which life is supposed to be seated, or in which its functions are carried on) in conjunction with the differences of mind, it will be necessary to give a description of the principal parts and of their use.

The skull or cranium is composed of eight bones, which united form a cavity which contains the brain. These bones are joined together by notched edges. If we break a wooden bowl in pieces, and place the parts together again as before, the irregular edges of these parts will give us a tolerable idea of the manner in which the bones of the skull are connected. The upper jaw is placed beneath the skull and the back parts of the lower jaw move in the skull in sockets. The hinder part of the skull is placed on the back bone. The back bone or spine is composed of twentyfour joints, which are placed one above another like the stones in a pillar; at its lower extremity there is a large cylindrical bone

called the os sacrum. Seven of the joints of the spine belong to the neck, twelve to the chest, and five to the loins. They are connected by ligaments.

The back bone is perforated throughout its whole length, and the cavity contains the spinal marrow, which proceeds from the brain. There are usually twentyfour ribs (twelve on a side), each of which is connected by ligaments with two joints of the back bone. Fourteen of the uppermost are joined by cartilages in front with a long flat spongy bone, called the breast bone. Ten of the lowest are called short ribs, and diminish in length to the breast. The conical cavity formed by the ribs contains the heart, lungs, liver, &c. The shoulder blades are three cornered flat bones; they are placed on the upper ribs and are loosely connected with them by ligaments. The collar bones are strongly tied to the upper corners of the shoulder blade, and also to the upper part of the breast bone.

Each arm has a long round straight bone, whose superior extremity has a rounded head bending inward: the head plays in a socket formed in the upper corner of the shoulder blade, and is firmly tied down to this bone.

The lower part of each arm or the fore arm has two bones, which are placed side by side in the natural positions of the arm; the upper extremity of the outermost of these bones projects beyond the end of the other, and the rounded notch thus formed plays upon the lower extremity of the arm bone, and on the lower end of these bones the hand is placed.

The cavity at the lower part of the trunk, is formed by two large thin hollowed bones (hip bones) which are united behind by cartilages and ligaments to the os sacrum, and before, in their lower corners by a cartilage. Each thigh has a long round straight bone; the superior extremity of which has a rounded head bending inward and playing in a socket in the hip bone, and is firmly connected to this by ligaments. The inferior extremity of each leg has two bones; the smaller in the natural position is rather behind the other; the upper part of these move on the lower extremity of the thigh bone, and the lower part is joined to the foot. The bones of the arms

and legs are hollow, and contain a fatty matter, called marrow, in membraneous cells; most of the other bones contain marrow in bony cells. Many nerves and blood-vessels pass through all the bones into the marrow. They are covered by a soft fibrous red colored substance, called flesh or muscle. Muscular fibres not only form our flesh and what we call *muscles*, but are found in the viscera, and produce our internal as well as external motions.

The most of the muscles are attached at one end to some bone, where they are round, hard, and of a shining whiteness; from this place their fibres usually diverge until they are red and confounded with the muscular flesh. Some, however, are connected to bones at both ends, and others again have each extremity terminating in flesh.

The muscles are so connected with the bones and flesh, that when any one muscle becomes shorter by contraction, it has a tendency to move a limb to which it is joined: thus when the muscles at the inside of the elbow are contracted, it tends to draw up the fore part of the arm, and when the muscles at the back of the elbow are contracted, it tends to straighten the arm. The muscles are contracted by our will, or whenever they, or the nerves connected with them, are irritated in any way: as when they are pricked, or when something acrid is applied to them; by a change of temperature, or by electricity or galvanism.*

The substance which lies between the skin and muscles, which is insinuated between the muscle, and which is interposed between the different parts of the body, is called *cellular membrane*. It is composed of very delicate membraneous layers, so arranged as to form cells, which in some parts of the body contain a small quantity of fluid to keep it soft and flexible, and in other parts are filled with fat, which is also absolutely insensible, or contains no nerves, and generally composes one twentieth part of the weight of the body.

The organs of digestion consist in a long canal extend-

* Cramp is occasioned by the muscles contracting involuntarily.

ing from one extremity of the body to the other, and is about thirty feet in length. Into this the conduits of various glands situate near it open: these glands abstract or secrete from the blood certain liquors, which serve to alter and digest the food. The whole body is penetrated with small tubes (lymphatics) which serve to carry certain fluids from one part to another; every pore of the skin is an extremity of one of these tubes. Sometimes moisture is absorbed by the pores, and carried over the system by the lymphatics, at others moisture is brought by the lymphatics to the pores of the skin, and is there thrown off in perspiration.

From the various parts of the alimentary canal, arise small tubes, which absorb the chyle or the nutritive part of the food, separated by digestion. These tubes, after uniting with other absorbents, and passing through many glandulous bodies, at length unite and form a large canal, called the *thoracic duct*, which empties into a vein and is carried to the right division of the heart.

The heart is a great muscular bag, situated in the breast, and is divided into four cavities, the right auricle, the right ventricle, the left auricle, and left ventricle. From the left ventricle a large artery called the aorta, proceeds, which carries blood to all parts of the body; after rising a little and sending off branches to the head and each arm, it descends at no great distance from the back bone, and at the lower part of the trunk it splits into two parts, which go to the legs. The various branches of the aorta suffer numberless ramifications, by which the blood is carried to every portion of the body however small; the little blood vessels then turn back towards the heart, and take the name of veins. They unite as they proceed; those from the superior extremity are collected into a single vein, and those from the inferior are collected into two, which unite at the lower part of the trunk; this vein then proceeds upwards and joins that from the superior extremities, and the blood as well as chyle and lymph conveyed into this great vein by the thoracic duct is poured into the right auricle of the heart. The auricle as soon as filled contracts: the blood is hindered from running back into the veins by a valve, and

is forced through a large opening into the right ventricle; this immediately contracts, and the blood being stopped from flowing back into the auricle by another valve, is driven into an artery (pulmonary artery) which passes into the lungs, and is divided into an infinite number of branches, so that all parts of the blood may come nearly in contact with the air. After passing through the lungs the blood vessels unite into four veins, which pour it into the left auricle; this, on being filled, contracts, which sends some of the blood back into the lungs, but most of it into the left ventricle. The ventricle then contracts; the passage of the blood back into the auricle, is impeded by a valve, and it is driven into the aorta and carried over the body, which converts part of it to its own substance, and sends the rest back by the veins to the heart. The two auricles contract at the same time, as well as the two ventricles.

The blood in the arteries and in the left auricle and ventricle, is of a florid red color, and that in the veins right auricle and ventricle, of a dark color. The lungs are composed of two large organs called lobes, and are shaped something like the hoof of an ox, the back side being before: they are situated in the upper part of the chest, and nearly cover the heart, which is placed between them. The wind-pipe commences in the upper part of the throat, and after passing down a small distance, splits into two parts, each of which passes to one of the lobes, and divides into millions of little tubes through it.

The lungs are a soft spongy texture, consisting of cells, which communicate with the branches of the wind-pipe.

The heart, it is plain, is supported by the arteries and veins. The lungs are supported by the pulmonary artery. The heart is inclosed in a thin arc, called the *pericordium*, and each lobe of the lungs in one called pleura. The heart and lungs are confined in the upper part of the chest by a thin integument called the diaphragm. As the air when expired contains some carbonic acid, with less oxygen and the same quantity of nitrogen as when inspired, it is supposed that the venous blood driven into the lungs owes its dark color and impurity to the carbon it contains, and that the oxygen unites with

the carbon of the blood and of the chyle contained in it, which produces the carbonic acid as well as the heat of the body.

The liver is a large soft red body; it lies principally on the right side, below the diaphragm, and secretes a large quantity of blood from a vein which passes through it. The bile is a secretion from the blood of this organ, and empties into the alimentary canal. The kidneys are situated in the lower part of the trunk on each side of the spine; they secrete the urine from the blood, and empty into the bladder.

The whole of the cavity of the skull is filled with the brain, and from this proceeds a branch called the spinal marrow, which occupies the hollow in the back bone. From the brain and spinal marrow, small branches or nerves proceed through minute apertures in the skull and spine to every part of the body.

The nerves are the organs of the sensations, and the brain is their common centre. These are all the parts of the human body which it is necessary for our purpose to describe. The predominance of particular organs, or systems of organs, modifies the whole animal economy, and has no less influence on the intellectual than on the physical faculties. This predominance forms the temperament; it is the cause and essence of it. If the organs held a proper relation with each other in size and energy, there would be no temperament: but this constitution of body is no more found than any other perfection in human things.

There are usually considered six temperaments: the sanguine, muscular, bilious, melancholy, phlegmatic and nervous.

Anatomists have always observed great differences in the capacity of the breast. A breast of large size is almost always accompanied with large lungs, and the volume of the lungs commonly determines that of the heart. It is well known that the function of the lungs, is to breathe the atmospherical air; we have said that they decomposed the air received into their cavities, and by that means modified the venous blood carried through them and fitted it again to pass through the arteries. Of course, other things remaining the same, the greater the lungs,

the more blood will be purified and forced into circulation, and the quicker and stronger must be that circulation; and though there may be many things uncertain with regard to animal heat, yet we know that it depends on the quantity of air respired. Again, if there is a great energy in the circulation, the muscular fibres will generally be supple; and the cellular membrane well filled with juices: for this energy in the circulation will keep all the vessels open and free, and will carry to every part a sufficient quantity of humors. The features and all the joints, will be rounded for the same reason, and the face will often be of a florid color.

Individuals of these qualities, are generally of an ordinary stature, well proportioned, with chesnut hair; the pulse is undulating and smooth, and their smiling countenances show the ease of their minds. Their nervous susceptibility is lively, and easily affected by external impressions; and this would naturally be supposed, as the extremities of their nerves are spread out in cellular membranes, which on account of the vigor in the circulation, is well supplied, but not over-charged, with juices. Persons of this description, have the temperament called sanguine. All the operations of the mind are performed with celerity: but this great celerity itself, combined with the ease with which they are affected by external impressions, keeps the mind from being occupied any great length of time with the same object. The thoughts are quick, lively and constantly changing from one subject to another. Pleasure finds among the sanguine its greatest votaries.

Men of this temperament would vainly endeavor to meditate profoundly on abstract things; to consider a subject in all its intimate relations, or to persevere in a line of conduct, which promises only remote advantages, or in the belief of doctrines which require deep reflection in order to be fully understood. In their judgments they are affected only by what is lively, striking, and presented almost without effort to their minds. Of course, their opinions are quickly formed on any subject that is presented to them, and they are decided in them for the time; but on a second consideration, they often find

new relations, while some of the former ones are not perceived: their determinations are therefore liable to vary. The passions too of such persons are sudden, sometimes violent, but soon appeased, and the dispositions are generally benevolent. The sanguine are better fitted for brilliant and light productions of the mind, or anything in which imagination and address are required more than understanding and reflection. Mark Antony and Alcibiades, may be given as models of this temperament. The negroes and the inhabitants of the north of Europe are in general naturally sanguine.

The ordinary diseases of the sanguine have their seat in the circulatory system, and are inflammatory fevers, inflammations, hemorrhages, apoplexies &c: they are brought to a close by simple remedies, such as bleeding, &c. If persons of this constitution of body take much exercise, their muscles acquire great volume and strength, and the muscular temperament is the result. In persons of this temperament, the head is comparatively small; the neck large, as also the shoulders, breast and hips; the intervals between the several muscles are plainly to be seen.

It has always been observed that the most robust persons, or those whose muscles are the largest and strongest, are generally least sensible to impressions, external or internal, and have little imagination. The ancient wrestlers were regarded as stupid men; the adventures of Sampson and Hercules, conducted without calculation or reflection, show the attributes of the muscular. They were courageous, because they were strong, and certain of vanquishing all their enemies from former experience of their own powers: but still they had no sort of cunning; they were constantly deceived by all around them. No one of this temperament has ever distinguishied himself in the sciences, the fine arts, or in any occupation which requires taste or address. As the nervous sensibility of the muscular is not great, they are not conscious of disease until it has made some progress in them. Their disorders are therefore much more dangerous than those of the sanguine.

Persons in whom the liver is the predominant viscera,

will in general have no excess of flesh, or rather will be lean; the pulse will be quick and strong; the biliary juice abounding; the muscular fibre or flesh firm, and will have a considerable degree of tension; the hair will be dark; the subcutaneous veins jutting out, the features and all the joints prominent and sharp; eyes sparkling, and skin of a brown inclining to yellow.* All these qualities united in the same individual form the bilious temperament. In the bilious the nervous sensibility is lively and easily moved; the affections are sudden and violent: but though they are impetuous and changeable in their passions, disgusted today with what they embraced with transport but yesterday, yet their character is firm and unbending, and their opinions are formed after a greater reflection than with the sanguine, and of course are more permanent. As love is the governing passion with the sanguine, so ambition is with the bilious. If a man wish to be elevated to a particular station in life, he must possess great dissimulation, the most obstinate perseverance in his plans, and should have the power of keeping them in all their relations constantly in his mind. These are the distinguishing characteristics of the bilious. Their projects are bold, they pursue them with untiring assiduity; courageous, active, and decided, their virtue or vices have at all times caused them to be regarded with admiration or terror.

We find among the bilious most of those who at different times have raised themselves by their genius from a private station to sovereign power. Such were Julius Cæsar, Mahomet, Cromwell, Cardinal de Richelieu, and Bonaparte. Again, we find in this class, most of those who have shone as statesmen or warriors, who not only have formed the greatest projects for the melioration of the human race, or to effect some darling object, but who have joined heart and hand in their execution. Philip, Alexander, Hannibal, Brutus, the Czar Peter, Sixtus the fifth, and Washington, are examples of the bilious of this description.

The character of Philip illustrates the qualities of this

* This is owing to the bile which is often carried into the blood.

temperament: his plan of consolidating all Greece into one empire was steadily pursued from his earliest years; every action which could conceal his design, or forward his purpose was performed. Was it necessary to calm the suspicions which a powerful state entertained of his ambitious designs: the greatest sacrifices were made. Was there a party existing in any state, which his influence could render predominant, and subservient to his views: his influence was immediately exerted. Would a distant period, five, ten, twenty years, be better fitted for the execution of an enterprise: he waited the favorable moment. Could immediate exertion put him in possession of what he desired: he was like the eagle of heaven pouncing on its prey.

The illustrious Washington for years prosecuted the scheme of protracting and wearing out campaigns, though it exposed him to contempt and ridicule, and in this way conducted his country to glory and independence.

Individuals belonging to the Celtic branch of the European race, are more often bilious than those belonging to the Gothic branch. This temperament is characterized by the precocious development of the faculties of the mind. Many of the bilious, even in the first stages of youth, have projected and executed enterprises, which would have done honor to persons of mature age. The diseases of the bilious in general have the derangement of the functions of the liver, or of the organ immediately connected with it, as the first cause, or as an accessary. Purges and emetics, are considered as the best medicine.

The bilious temperament, or at least its physical traits are as we have seen extremely marked, but still some small changes produce another temperament. In place of the wide breast which accompanies the voluminous liver and large lungs, found in the bilious, a state of things entirely different is produced if the breast is small, and keeps the viscera contained in it in a contracted situation. When this is the case, we in general find that the circulation is performed with languor and feebleness; the skin is of a deep pale color; countenance

sad, and strongly marked, and all the joints sharp and projecting; eyes sunken, with a look which indicates concealed thought; body tall, but slender and lean, the extremities long; pulse little and slow; hair dark and straight; the flesh will be firm, and will have a great degree of tension. When all these qualities are united in the same person they form the melancholy or atrabilarious temperament.

The melancholy, though they appear feeble and incapable of supporting hardships, are remarkably strong, and sustain fatigues and exposure with ease and patience. All their actions are slow and circumspect. In discovering the truth or falsity of any opinion, they view it in every possible light, and form their judgment only when they have considered and felt all its relations. To this perhaps, more than to a direct physical cause, is owing the want of *prompt* decision, and that suspicion of their own opinions, and of those of others, which characterize persons of this temperament.

The impressions of the melancholy are neither numerous nor rapid, but they have a great profundity, and are retained with an obstinacy which nothing but death can separate from them. This is the reason why they are confused by having too many things pressed upon their attention at once, and why they like to meditate in solitude and silence. As they are ever suspicious and diffident in drawing conclusions from any opinion or belief which they have not considered to their satisfaction, so when they are once convinced of the truth of any sentiment, it becomes one of their principles of action through life. Their language is strong and figurative, they speak like men fully convinced of the truth they would persuade others to believe.

The appetites and desires of the melancholy appear like passions, and their passions are lasting and endure as long as their existence. This is the reason why love is so serious a thing with persons of this description; constant friends, they are implacable enemies. Living with others in a reserve bordering on suspicion, they consider even the lightest shades of their character, and are ever ready to make unfavorable interpretations of

their actions. These dispositions are aggravated by a memory, which retains the slightest circumstances, and by an imagination which is continually active. The melancholy are in general virtuous or extremely vicious, and are either fearful and timid or possessed of a desperate courage.

Tiberius and Louis XI. were of the melancholy temperament, and the history of these perfidious, fearful and suspicious tyrants, who sought solitude because they hated all the world, and left their seclusion only for scenes of barbarity and debauchery, shows to what length vice may be carried.

As the courage of the melancholy does not arise from blood and spirits, but has its foundation in the mind; they are as cool, collected and fearless in the day of battle or on the scaffold as in their loved solitude. Epaminondas, the Theban general, had a temperament melancholy in the extreme; he even built a house in the wilderness, where he spent many years of his life. When his colleague Pelopidas and himself were summoned before the Theban tribunal to be judged by the capricious multitude for alleged crimes, Pelopidas, who never feared in the day of battle, was terrified: but Epaminondas despised death in every shape, and that contempt of life and of his unjust detractors not only saved his life and that of Pelopidas, but gained them the highest honors.

Among the other illustrious men of the melancholy temperament we find Tasso, Pascal, d'Alembert, J. J. Rousseau, Zimmerman, Newton, Jefferson, Count de Tracy and Bentham. This constitution of body is often not the one which is natural, but which is produced by excessive and long continued grief, by obstinate studies, or anything which causes the imagination to be violently affected for a great length of time on the same subject. The mind therefore often determines or changes the state of the body, as well as the body does that of the mind. The ordinary opinions of people concerning the minds and mental peculiarities of those who possess the physical traits which we have described as belonging to the bilious and melancholy temperaments, are in general very correct: thus, a man with a marked countenance

and a thin habit of body is said to be 'a long headed fellow,' and the vulgar proverb, 'never buy a pig with sharp joints and lantern jaws *unless you intend it for a learned profession*,' involves an idea which is near the truth. The pictures of cruelty, of the furies, and of death, are tall, slender, have pale countenances with every feature prominent, and are meagre or entirely deprived of flesh. This corresponds exactly with what we have said: that the melancholy (which have these physical characteristics) are virtuous or vicious, and either have a spirit of universal benevolence, or commit the most horrid barbarities apparently without remorse.

The melancholy are subject to obstructions in the organs of the abdomen, to derangements in the functions of the nervous system, and it is among the bilious and melancholy that consumptions are most prevalent. The North American Indians are generally possessed of the melancholy temperament, and it is very common among the inhabitants of England, the south of Europe, and Asia.

Those individuals, in whom the liver secretes but a small quantity of blood, and in whom the bile lacks energy, in general the breast and lungs will be of a large size; but the lungs will be loaded with fat in such a manner that their capacity will be but small; the lymphatic system will be developed in an extraordinary degree, and the cellular membrane filled with humors; the flesh will be soft and flabby; the hair straight and of a dead color; eyes feeble; the features and joints will be smooth and rounded and the countenance will want color and expression; the body will be of the ordinary height, but thick; the pulse feeble and slow.

When the same individual possesses all these qualities, which we have said will generally be the case when the liver secretes but a small quantity of blood, and when the bile lacks energy, the phlegmatic temperament is the consequence. The sensations are dull and make no deep and lasting impressions; the memory and all the passions are weak; their ideas few and slow, but tolerably clear; their affections mild and constant. All actions which require boldness, promptitude, decision, or obsti-

nate study, or courage, they are wholly inadequate to perform. But they are pleased with such as they can perform tranquilly, and at leisure. As neither the external nor internal impressions are lively, they have neither the vivacity, the gayety, nor the changing character of the sanguine: but like the melancholy, pursue one line of conduct for a great length of time. The phlegmatic and melancholy temperaments however, in almost every other respect, are very different, and indeed in this case the phlegmatic may be said to remain in a certain course of life, rather than pursue it. The ideas, sentiments, virtues, vices, and indeed every moral, as well as physical attribute, appear in them with a character of mediocrity; but with all these disadvantages, added to a natural indolence of character on account of their mild and unchanging disposition, and the ease with which they bend their opinions and inclinations to those of others, they often succeed in gaining and preserving an unbounded influence over men of the most violent disposition. The appetite and digestion of the phlegmatic, are feeble, and in this they have a character directly opposite to the bilious. Their diseases are principally catarrhal, or are owing to some derangement or obstruction of the lymphatic system, and the most efficacious medicines are stimulants of various kinds.

We have no celebrated men of this temperament; for as we have said, they have a character of mediocrity.

The phlegmatic temperament is found principally in cool humid countries, as Holland. It is caused in these countries, perhaps, by the moisture absorbed by the lymphatic system from the air.

That sensibility to impressions, which is very slight in persons of the muscular temperament, feeble with the phlegmatic, lively with the sanguine, energetic and profound with the bilious and melancholy, when the vivacity is extreme, forms the nervous temperament.

The nervous temperament does not appear to depend on the great quantity of the brain or nerves, nor on any peculiarity in their arrangement, which is observable, but on the most intimate part of our organization.

When the nervous have strong muscles, the sensations

are not only lively, but durable; on the contrary, when the muscles are weak, the sensations are lively, but superficial, and the opinions and judgments are formed suddenly, and usually are very variable. In general the muscles of these persons are small, body tall and not overcharged with flesh. This temperament is more difficult to be recognised than any other; in the sanguine, muscular bilious, melancholy or phelgmatic, from a few very distinguishable peculiarities of body, we almost universally find particular qualities of body and mind to correspond, and vice versâ: but the nervous temperament is discovered only by the great vivacity of the sensations: and though one may readily observe a lively sensibility in himself, yet for obvious reasons it is not so easily discovered in others. This is not in general a *natural* temperament, that is, a temperament which we are born with, or which we would possess if our faculties were regularly developed, but one which is acquired by a sedentary, or inactive life, by indulgence in pleasures, or, by an exaltation of the ideas often occasioned by reading romances, &c. Of course the nervous temperament is found only in civilized countries, where man is farthest removed from the state of nature.

Vaporous women in whom the inclinations, though changeable, have an absolute ascendency over them for a time, present all the characters of this constitution. Voltaire and Frederic the Great, are examples of the nervous temperament, and the history of the lives of these celebrated men show in what manner this temper of body is acquired.

As the disorders of these persons are generally occasioned by derangements of the nervous system, often attended by convulsions, the most proper medicines to be used are those which are called anti-spasmodic, or which diminish, and tend to calm the irritability of the nerves.

As all temperaments are occasioned by the predominance of certain organs over others, we may regard them as true disorders, or at least as the commencements, the first stages of disorders.

We are not to suppose that all men have one or other of the six temperaments, such as they have been descri-

bed, though the constitution of every person may have a tendency to a particular one, and this tendency in some is very great and in others small. It would be in vain to seek an individual completely sanguine, muscular, bilious, melancholy, phlegmatic, or nervous: as completely so as to find one in whom all parts of the system are in such a relation, that there would be no temperament.

The constitution is often altered in various ways as we have already observed; man never remains as he came from the hands of nature: sickness, climate, food and a thousand other things act upon him, and like all other terrestrial beings he is continually changing. It is not at all unfrequent for a person in youth to be possessed of a particular temperament, and in middle or advanced age to have another entirely opposite. Thus the sanguine, not unfrequently changes to the melancholy, though the melancholy rarely or never becomes the sanguine, or indeed any other, whatever may be the way in which it is treated. The bilious passes with great ease to the melancholy, but in this case it retains many of its original peculiarities; it rarely becomes the sanguine, and the phlegmatic, only by a complete degradation of the constitution. A difference of age or sex also causes a great diversity, not only in the physical, but also in the moral or intellectual attributes.

In young* persons of either sex, and in woman, all parts of the body are softer; the circulation is performed more feebly than in men; the cellular membrane is well filled though not over-charged with humors, their sensibility is in general very great; and for these reasons when compared with men, they appear more like those who possess the nervous temperament with weak muscles. Their imagination has a much greater empire than their judgment; as the circulation is not so strong as in man, they lack that animal courage and resolution, which belongs to his nature.

It is useless to advance the doctrine that woman might be taught to contend on the field of battle, to prosecute a protracted course of reasoning, or to pursue a course of

* Before the age of puberty.

life in which firmness and perseverance are requisite. Her physical conformation is such, that she never can have the courage and resolution of the warrior: these two qualities in general depend upon a consciousness of strength, and upon the weakness of the sensation of danger. She feels her want of force, and is alive to every sensation external or internal. As her impressions are lively and varied, she is constantly diverted from abstract meditations by attention to sensible objects, and by her imagination. From the delicate formation of her body, her physical as well as intellectual susceptibility of pleasure or pain, is much greater than in man. From her great sensibility, she constantly experiences impressions of an unpleasant and also of a pleasant nature, and this may serve to fix that character of instability of feeling, otherwise so natural. It would be doing injustice however to the intellectual faculties of the female sex, and of children, to suppose that their judgment in *general affairs* is developed in the greatest possible degree, or in a degree approaching this. The judgment can be improved only by being employed. With regard to young persons of both sexes, their early education is not favorable to the exercise of the judgment. In learning the alphabet, they understand, from what they have been told, that it is the manner in which they must learn to read. When they are taught to pronounce words, they find that the letters in them rarely have the same sound as in the alphabet, even when the words as we say are spelt as they are pronounced. It is still worse with words which are not spelt as they are pronounced. In the first case the young scholar can see no good reason why a letter in one situation should not have the same sound as in another; he imagines that there is some hidden some unseen reason for it; he is perplexed, when he comes to words in which the orthography has little or no relation to the pronunciation, (which is the case with a large proportion of those belonging to most of the European languages) he can perceive no reason for it; his ideas are confused; as he cannot believe that great, learned, and wise men would permit a thing which has so great consequences for him, and which appears so utterly useless; after many

and great endeavors to understand it, he surrenders his judgment entirely, and takes for granted that it is as it should be.

Years are spent (and in a majority of instances with but a partial success) in merely learning to spell. His judgment in this, is not exercised, or rather is cramped and restrained. As he thinks that there must be some cause why the orthography of words and their pronunciation should be so different as to oblige him to devote the best portion of his life in attaining that, which he might otherwise do in the course perhaps of a few hours; so he believes that there is some mysterious reason, which is only understood by the most profound scholars, and which his feeble intellect is wholly unable to comprehend, why he must occupy a length of time so great, and undergo so much pain, in learning the orthography of words, which he has never seen employed, and which he probably will never have occasion to use.* In the study of grammar, he can see no advantage, except when it serves to correct blunders in the use of language. Now the errors committed in speaking and writing, even by the most ignorant part of the community, he sees are not very numerous; they may be learned by a few days' study. The young scholar perceives that the most learned men think that an education is very deficient without a complete knowledge of the rules of grammar; he again imagines that there is some mysterious reason for this, and prides himself on the knowledge of principles, which appear to have no particular application to his wants. After he has thus been led to believe that he is totally incapable of forming a correct opinion in so many cases, and where it appears to him that he is as well capable of judging as any other person, he distrusts himself entirely; he dares not think for himself; he depends on older people to calculate for him.

It may be supposed by many, that these things do not have so great an effect on the minds of young persons as we have here insinuated: yet it is believed, that such circumstances, though they may appear small to those

* A great majority of the words in our *spelling books* are of this kind.

who have not fully considered the subject, have a most decided influence. This opinion, to which we are conducted by theory, is warranted by facts; uneducated children have a judgment on any subject, far more correct than those who have commenced their studies; other things being equal.

We do not intend here to advance the idea that the alphabet is not the best that can be imagined, that words are not spelt and pronounced as they should be, nor that the study of grammar in the ordinary way, is not the most proper; but only that certain effects follow from the study of certain things. Neither do we intend to say that these effects have in the main a bad influence on the mind: but only that our early education cramps the judgment, from the influence of causes which we have specified.

We have also said that the inferiority of the judgment in females in general affairs, was not entirely owing to temperament. Their minds are not occupied with those concerns with which it is important that man should be acquainted, and a knowledge of which he thinks all important. Woman thinks of those things which are of the most consequence for her; her interests are different from man's. He labors principally to improve his property, or advance his honor, she to perfect herself in the arts of pleasing. She well knows that to gain the reputation of being learned, or to become acquainted with the details of business (if her capacity should be sufficient) is not the way to do this; but that it has a contrary effect. Her conduct is governed accordingly; she cultivates the arts which require a lively imagination, and nice sensibility, as well as taste and address; such as music, dancing, grace in movements and expression. On these accounts it is not to be expected in a majority of cases, that she should be able to carry on a long train of reasoning on any subject, nor that she should be able to judge accuritely of things with which she is not acquainted. But when she can feel all the qualities of the thing she contemplates, that is, when all the qualities of it present themselves to her mind without effort, then she forms her opinion immediately, and in general very cor-

rectly, and this not only is what observation shows to be true, but what is easily deduced from what has already been advanced.

There have been a few of the weaker sex who have distinguished themselves in the sciences; but making proper allowances for the great admiration and exaggeration which circumstances like these always produce, we may safely conclude that the progress made has in no instance been very great. But even if some women approach men in their intellectual faculties, it by no means disproves what we have said; it is no more strange that the minds of women should occasionally overleap the boundaries prescribed by nature, than that their physical conformation should sometimes resemble that of men.

Though the general temperament of woman when compared to that of man, is so different, yet when the various constitutions of the softer sex are compared among themselves, they differ as those of men; we have women, sanguine, muscular, bilious, melancholy, phlegmatic and nervous. The sanguine temperament is the most prevalent among them. It seems a happy provision of nature that they should be endowed with a conformation of body, in which the ideas are always lively and gay, and in which grief or anger, though violent for the time, is soon extinct, and the mind like water rippled by the passing breeze, quickly recovers its accustomed smoothness and serenity. Formed to suffer their sorrows and disappointments in silence, if they possessed the meditating character peculiar to the bilious or melancholy temperaments, which retains with obstinacy the most trifling circumstance that causes the least pain, and is continually revolving it in the mind, they would be exposed to unnecessary afflictions. It is different with man; his engagement in business keeps his mind and body occupied, and drives away every painful thought.*

From the age of childhood, in which the imagination has a great activity, we pass to that of youth. In this state all parts of the body become firmer and stronger; the circulation is performed more vigorously; the sentiment of feebleness so common in the first stage of our

* See NOTE at the end of this Tract.

existence here leaves us; we feel our strength of mind and body, and imagine that there is nothing which we are not able to perform or acquire. Experience soon corrects these illusions, and the complete development which all our bodily organs acquire in middle age, is accompanied by a corresponding change in the mind. The many confused ideas which we acquire in our early years, are now considered as occasions make necessary; distinct notions are formed of objects; the imagination becomes less lively, and the powers of reasoning are perfected. As the body decays and becomes rigid with age, the intellectual faculties are impaired; old ideas, prejudices, and manners of thinking are retained; the mind cannot be diverted from the course in which it has moved. Late impressions are soon forgotten; it sometimes is even impossible at the end of a sentence, to remember the idea which was expressed at the beginning. The most interesting conversation often appears to them only a dull sound, the sense of which they cannot perceive; but ideas which they acquired in youth, retain all their strength. In this manner, the mind and body gradually lose their strength and vigor, until that awful and ever dreaded moment arrives, in which all our earthly pleasures and pains must have an end.

NOTE.

It is very probable that many of the readers of this tract may, after making themselves acquainted with the differences of temperament which it is its object to describe, endeavor to apply the theory to individuals. They look about therefore among their acquaintances and friends, and endeavor to assign to each one his place according to this system. Now, this will, in many cases, be difficult, or perhaps impossible, for these distinctions, though real, and of great importance, are not always strongly marked in every individual. You may for example look around a circle of fifty persons, and perhaps not find in more than one or two, decidedly well characterized specimens of the san-

guine temperament. There may be many who will partake of the peculiarities of more than one of these distinctions. The varieties which have been enumerated are rather the elements of the human character, as affected by the bodily conformation, which elements in different individuals are variously combined, and mingled in every possible proportion, rather than distinct and separate classes, into which the human race may be divided. The inquiry therefore in regard to any individual ought rather to be, what temperaments combined, enter into the formation of his physical character, rather than to which of these classes he belongs.

We cannot forbear alluding to one practical use which may be made of the views exhibited in this tract. They will assist every one to understand more fully his own character. Every one who reads it attentively, and compares his own disposition with its descriptions, will comprehend more distinctly the tendencies of his mind, and the more readily see in what points he needs to be watchful, and on his guard against the approach of temptation. Many of the moral dangers to which all are exposed, arise from the influence of the physical system. This system ought therefore to be understood; that the occasions of doing wrong which it presents, and the peculiar exposures to which it is liable may be foreseen and guarded.

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PHILOSOPHY.

The human mind can acquire no knowledge by a process of reasoning, unless it first have some knowledge to reason with. It must have some capital with which to commence business. Whence the origin of its knowledge possessed antecedently to its reasoning operations?

The Pythagorian and Platonic philosophers maintained what is called the doctrine of 'innate ideas.' They supposed that there is concreated in the substance of the human mind certain 'eternal and immutable ideas,' which constitute its original stock. The same doctrine has been since substantially maintained by Descartes. The Aristotelian and peripatetic philosophers denied that any ideas have their seat primarily in the mind, maintaining that there is 'nothing in the intellect which was not at first in the senses.' They supposed that from all external objects proceeded images resembling themselves, which are transmitted through the senses to the mind, and there constitute ideas. The dogma of the Epicurian philosophers was still more gross, who supposed that the mind itself is material, and that all external objects emit very minute and subtile portions of matter, in the form of miniature representations of themselves, which, entering the mind through the medium of the senses, become its original ideas and are the moving causes of its subsequent operations. Malebranch, and others of his school, supposed that our original ideas are possessed by us in common with the Deity, or are the immediate production of divine efficiency; while others still supposed that our minds are so

constituted by the Deity in his own image that we can, like him, originate ideas from nothing.

The true doctrine on this subject appears to be the following. Our minds, as they come from the Creator's hand, have no innate ideas; but they are constituted with capacities or faculties for acquiring knowledge, adapted to the condition of our being. Our first simple ideas, or notions of things, are obtained through the medium of our senses, by the direct perception of external objects; and such is our mental constitution, that we instinctively and immediately perceive their agreement or disagreement so far as to possess ourselves of the elementary facts or first principles of knowledge. The knowledge thus received is called intuitive knowledge, and the receiving of it is called intuition. Our first ideas are thus, those of things and the relations of things around us, addressed to our minds through the bodily senses. A child for the first time sees an orange; the distinct idea of an orange is then produced in his mind. He sees it divided; he instantly perceives the relation between the whole and its parts — he perceives that the whole is greater than any of its parts, and that the whole is equal to the sum of all its parts. In a similar way his mind receives all its simple ideas of things, and the relations of things, thus evincing its constituted capacity to intuitively recognise elementary truth, the instant it is perceived. Hence, through whatever sense, or by whatever means, you convey an intuitive truth to any individual of a sound mind, the moment he comprehends it he receives it as a truth. No demonstration can make it more evident to him. The idea contained in that truth was not innate — not concreated in his mind — but such is his mental constitution, that he receives it as soon as presented, without any process of reasoning. In this way we receive all our elementary stock of knowledge.

The distinction then between intuition and reasoning is apparent and highly important. Intuition is the passive and instinctive perception of things and the relations of things, the agreement or disagreement between

two or more simple ideas without the intervention and aid of other ideas. Reasoning is that active mental process in which we go on to enlarge the compass of our knowledge received intuitively, by variously comparing, combining, compounding, multiplying, and generalizing our intuitive knowledge, and thus demonstrating truths by a process of mental acts, which we do not know immediately by intuition.

Divine economy is however here manifested, in giving to the human mind as little knowledge in this easy way of intuition as can possibly suffice to begin with. Like the wise father, who gives to his children only enough to set out with in life, and casts them upon their own diligence for the remainder, instead of giving them so much as to encourage idleness and thus spoil them, the Creator has wisely given us to possess by intuition what is barely sufficient to commence our immortal active career of acquiring knowledge; thus placing us under the necessity of enlarging, strengthening, and disciplining our mental powers by exercise, for the entertainment and right use of knowledge, while engaged in obtaining it. Thus action is the first law of mind, and industry is the parent of knowledge.

As we are both intellectual and moral beings, we are capable of receiving by intuition knowledge both of an intellectual and moral nature. It is necessary to us as moral beings, no less than as intellectual beings, to have some knowledge with which to begin.

Our intuitive *intellectual* knowledge includes all simple ideas received by sensation, the primary relations of simple numbers, the axioms of geometry, and the first principles or truths of all abstract science. Our intuitive *moral* knowledge includes knowledge of a natural distinction betweeen right and wrong, that we ought to do the one and avoid the other. that we ought to promote the welfare of the universe, that we are accountable for our conduct, and that the extent of our ability is the extent of our duty.

The faculty of making moral distinctions has been variously termed the moral sense, the moral guide, the inward monitor, and the conscience. Some have denied

that it is a *constitutional* faculty, asserting that it is *acquired;* and that all our notions of right and wrong are the result of education. Into this error they have fallen in consequence of not discriminating between the faculty itself and its specific judgments, differing in different circumstances and with different degrees of light. It were unphilosophical to say of a man who has always lived in a dungeon, that he has no eyes simply because he has never seen any object. It were likewise unphilosophical to assert of men living in different places, and viewing different objects all their days, that their eyes are good for nothing and cannot be trusted, because they do not all see the same things. All that is necessary to prove that a man has a *natural* eye is, that whenever natural light is afforded him, he do actually see natural objects. And all that is necessary to prove that a man has a *moral* eye, or a faculty of intuitively making moral distinctions, is, that whenever moral light is afforded him, he do actually perceive such distinctions. This all men do, from the earliest dawn of reason. We are then, in the constitutionof our natures, as really moral as intellectual beings; and in each of these respects destitute of innate ideas and equally in need of instruction. The foundation of morality or religion is thus laid by the Creator himself in the moral constitution of man; and philosophy is concerned with us as moral or religious beings, not less than as physical and intellectual beings.

All sound philosophy is a knowledge of facts in matter and in mind obtained by intuition or reasoning, and an arrangement of these facts in systematic and scientific order. It is often convenient, and sometimes even necessary, for philosophers in pursuit of knowledge to make use of hypotheses or theories; but these are really no essential part of their philosophy, any more than the scaffolding employed in building a house is a part of the house built.

Sir Isaac Newton, observing an apple fall from its tree to the ground when severed from its stem, was led to make the hypothesis that *all* bodies, when set at liberty at certain distances from the earth, tend towards it ac-

cording to some uniform law. He thence proceeded by induction to the proof of his hypothesis, and demonstrated not only that all bodies near the surface of the earth tend towards the earth, but that all bodies in the universe tend towards each other, with a force directly as their magnitudes and inversely as the squares of their distances. This tendency of bodies towards each other is called attraction. On projecting a stone from his hand into the air, he observed that it moved in an eliptical orbit, sweeping round from his hand to the spot on which it struck. He perceived that its orbicular motion was produced by the united action of the projectral force imparted to it by his hand, and the force of attraction, since called the centrifugal and centripetal forces of orbicular motion. In the spirit of true philosophy, seeking to deduce general principles, or in other words to learn the existence of facts on a large and general scale from particular facts, he was hence led to make the hypothesis that the planets move round the sun in eliptical orbits, according to the same law of centrifugal and centripetal forces. By a subsequent process of demonstration he ascertained it to be a *fact*, that the planets do thus move round the sun, and also that, so far as the observation of man can reach, all bodies travelling in the paths of the sky move in perfect accordance with this law. His hypotheses, like the scaffolding employed in building a house, were serviceable to him in erecting his magnificent philosophical edifice; — they served to elevate his mind from the contemplation of a single and comparatively trifling fact, to the demonstration of a fact vast as the material creation. But the knowledge of the great ultimate fact which he demonstrated, and not the hypotheses which instigated his demonstration, constitutes a part of his material philosophy. An hypothesis is then an assumption of a fact which remains to be proved, the subsequent knowledge of which fact, when proved to exist, constitutes philosophy.

But again, what *is* this mysterious something called attraction? Philosophy does not know. It only knows the ultimate fact, that all bodies do thus tend towards each other, and that all bodies moving in the heavens move in accordance with a uniform law of centrifugal and centripetal forces. Now comes the place for theory. Where

the demonstrations of philosophy end, theory begins. One man supposes that there is an *inherent* power of repulsion and attraction in matter. Another supposes that matter has no inherent power, but is only an *occasion* of divine efficiency. Another supposes that spiritual *life*, pervading the universe, repels and attracts all matter. Now whether either of these theories be true or false, does not alter the philosophical *fact* which they undertake to account for, and are no part of that fact. A theory then is a speculation or opinion respecting the mode of accounting for a fact, or of reconciling two or more known facts in philosophy; but is no essential part of philosophy itself, and for aught that is known at the time of its adoption, may be either true or false. It should be remarked however that a theory, as well as an hypothesis, whenever demonstrated to be true, is exalted from its state of probation to a rank with philosophical knowledge. It then no longer sustains the character of theory, but of fact.

Take also an illustration in intellectual philosophy. Mr Locke observed that the ideas of which he was himself conscious resulted from impressions received through the medium of his senses, and his reflection upon them. He was hence led to make the hypothesis that *all* ideas, in all men, result from sensation and reflection. By a subsequent process of demonstration he proved this to be a fact. His hypothesis preceded his knowledge; his knowledge is his intellectual philosophy.

But again, what is the connexion between the thinking agent and the organs of sensation? His philosophy does not know. Now comes theory. One man supposes that the soul is material, and that its acts of thinking are its minute particles set in motion in a particular manner, by particular impressions made upon it through the bodily organs. Another supposes that the soul is immaterial, and has its seat in the brain, and somehow through that organ maintains all its intercourse with the world without. Another supposes also that the soul is immaterial, but has its physiological seat in the membrane, brain, and nervous system, assigning to each of these a distinct function in its operations. The last is probably the true

theory, and may yet be demonstrated to be so ; but whether either or neither of these theories be true or false, does not affect Mr Locke's philosophical fact, that there is a soul or thinking agent connected with the body, acquiring all its ideas through the medium of sensation and reflection.

The soundness of Mr Locke's philosophy on this subject has been questioned by some, who suppose it impossible to refer the origin of all our ideas to sensation and reflection. Whether his philosophy be sound or not, does not affect the point of the present illustration ; but it should be remarked, that if we thoroughly study the constitution of the human soul, and then discriminate between its constitution and knowledge, and also between its intuitive and acquired knowledge, we shall find a sufficient origin for all our ideas in sensation and reflection ; and if we then consider that it is unphilosophical to assign more causes than are sufficient to account for any phenomenon, we shall hardly be able to sustain the character of philosophers ourselves, and call in question the soundness of Locke's philosophy.

Take also an illustration in moral philosophy. Dugald Stewart learned from his own consciousness that he possessed a moral faculty, by which he instinctively distinguished between moral actions as right or wrong. He was hence led to make the hypothesis that it is a universal faculty in the constitution of human souls, thus rendering the whole human family a race of moral, accountable beings. By extending his observations to other individuals, nations, and ages, he arrived at a conclusive knowledge of the fact that it is really so. But further, *why* do we consider one action right and another wrong? Now comes theory. Some suppose, among whom are Paley, Priestly, Hume, Hartly, and others, that it arises solely from our perceiving that one action tends to produce happiness and another misery. Others suppose, of whom Stewart is one, that this faculty is an original principle or moral instinct, of such a nature that it decides directly respecting actions as right or wrong in themselves, without regard to consequences. Now

there is probably some truth and some error in each of these theories; but however this may be, the known and important fact in moral philosophy remains the same, that mankind do possess this moral faculty from some cause, either in themselves, or in the constitution of things around them, or in both, by which they instinctively make moral distinctions, as certainly as they think, and are hence as certainly moral and accountable beings as they are thinking beings.

Illustrations of the distinction between philosophical knowledge and mere hypotheses and theories might be multiplied to fill volumes. A single example only has been here given in the respective departments of natural, intellectual, and moral philosophy, sufficient to just put the reader upon the important track of discrimination between philosophy and speculation — between knowledge and ignorance. It will appear in this view, that essential sound philosophy is concerned in nothing but facts, and that the real progress of real philosophy is exactly commensurate with the progress of our actual knowledge of whatever *is*.

Knowledge has been sometimes divided into three kinds, mathematical, historical, and philosophical. According to this division, mathematical knowledge is a knowledge of facts respecting the powers of numbers, their proportions and ratios, and the quantity of things. Historical knowledge is a knowledge of facts external and obvious. Philosophical knowledge is a knowledge of facts ultimate and less obvious: it is often defined to be a knowledge of the *reasons* of things. But this can mean nothing more than a knowledge of facts connected with those which we account for, and lying a single step back of them. All we can know respecting the reasons of things is, that certain facts are invariably consequent to certain other facts; and honestly the only real difference between the man of merely sound common sense and observation and the sound philosopher is, that the one goes a step or two farther than the other in his knowedge of facts. Mathematical and historical knowledge are then parts or modifications of philosophical knowledge. Adopting hence a generic definition, it follows that all

sound philosophy is nothing more or less than an exact knowledge and systematic arrangement of facts. Nothing else is real philosophy. But as facts are the basis of all truth, or rather as truth is a term representing facts, philosophy may be neatly defined the SCIENCE OF TRUTH.

Philosophy in its specific and commonly received import is divided into three kinds, natural, intellectual, and moral; the first including a knowledge of material nature; the second, of our intellectual powers; the third, of our moral powers. These definitions are not accurately significant; since our intellectual and moral powers are as truly natural — as truly facts included in nature — as material objects. This is one of the many instances in which preceding ages have bequeathed to us the inheritance of names adapted to their state of knowledge, but not to ours. For obvious reasons, the nomenclature of all sciences never keeps pace with the progress of knowledge. The definitions as here given are however universally adopted, and will not probably be soon altered.

The preceding remarks are designed to establish and illustrate fundamental and general principles, having application highly important to all the departments of intellectual and moral education; but the present limits restrict us to a few particulars.

1. The design of education is to discipline the intellectual and moral powers, and to acquaint the mind with facts. These two ends may be accomplished in the best possible manner, by the same means. Let the child be first referred to his intuitive knowledge, and be made to definitely understand that; let him be conducted hence to the observation and experiment of facts in nature, advancing from particulars to generals — from isolated facts to general laws — and such is the constitution of the human mind, and its wise adaptation to surrounding nature, that just in proportion to its progress in knowledge will be its progress in discipline.

It is then an error, into which some have fallen from not studying the wise adaptation and economy of things, that we are first to discipline the mind and afterward to store it with the knowledge of facts; — we are to disci-

pline it *by* storing it with the knowledge of facts; and this is to be done, not by crowding knowledge *en masse* into it, but by pursuing with it principally the analytical process from the beginning and ever onward.

It is hence that the study of the mathematical sciences is so highly salutary in mental discipline. In these distinct and exact sciences the mind is *compelled* to begin and proceed right — it is compelled to commence with a distinct recognition of its intuitive knowledge, to move forward from this point step after step in a path made perfectly luminous by intuition at every step; so that every step is real knowledge of an additional fact, and the last link in the chain of demonstration, be it ever so long, is as certain and firmly possessed knowledge to the mind as the first. Let a similar course, as far as practicable, be pursued in the study of nature generally — in physical, intellectual, and moral science — and while the mind will thus possess itself of real knowledge, it will acquire strength, firmness, and a business like character; speculation will give place to knowledge; the mind will become eminently a matter-of-fact mind. Its intellectual nerve will be strong, its character solid, its knowledge certain; it will not be liable to be 'tossed to and fro, and carried about by every wind of doctrine.'

2. The distinction sometimes assumed between what is called the philosophy of religion and the facts of religion, is unnatural and unfortunate. It is unnatural, because it supposes that philosophy and a knowledge of facts are two distinct things, whereas they are the same. It is unfortunate, because it is a fruitful source of misapprehension, and is to some even an occasion of supposing that religion is founded on little else than mere speculation. Moreover it is not sanctioned by the *usus loquendi*, as applied in reference to other subjects. Why should the term natural philosophy be applied to designate a knowledge of facts in material nature, and the term religious philosophy not be also applied to designate a knowledge of facts in religion? Why is philosophy knowledge in the one case, and speculation in the other? Are there not in religion, as truly as in material nature, demonstrable facts, — the basis of as real knowledge in religious

philosophy, as there is in natural philosophy? Certainly. If religion be reality, it is based on facts — facts in the constitution of the soul, and facts in the constitution and course of surrounding nature; and if the term philosophy be applied to religion at all, the knowledge and scientific arrangement of these facts properly constitutes religious philosophy; just as the knowledge and scientific arrangement of facts in material nature, constitutes natural philosophy.

But the truth is, many have not yet learned to discriminate in religion, as in other matters, between a knowledge of ultimate facts and mere hypotheses and theories. They have launched out into a multitude of speculations and baptised them with the name of philosophy. Others detecting errors in their speculations, or philosophy 'falsely so called,' have lost confidence in all philosophy pertaining to religion, and have concluded to dispense with it entirely. But others again, perceiving the impossibility of this, concluding that we must have philosophy in religion as well as in other matters, in order to secure the truths of religion from what they consider the caprices of philosophy, have instituted a distinction between what they call the facts of religion and the philosophy of religion.

Now it is evident, that by this distinction they mean just what is meant in the departments of natural philosophy, by the distinction between the hypotheses and theories employed in the service of philosophy and philosophy itself. Do you not see that when you have taken away all the knowledge of facts from Newton's philosophy, you have taken all his philosophy? Do you not also see, that you may take away all the hypotheses and theories that have ever been connected with his philosophy, and that yet his philosophy itself would remain entire? Do you not see that the same is true of intellectual and moral philosophy? And also of all the specific sciences — branches of philosophy in its generic sense? geography? astronomy? geology? mineralogy? botany? zoology? chemistry? All these have their hypotheses and theories, but they constitute no essential part of the sci-

ences themselves. Our perfection in each of these sciences is exactly commensurate with our knowledge and systematic arrangement of ultimate facts involved in it. From either of them you may remove all hypotheses and theories, and yet the present degree of our perfection in the science itself would remain entire.

To present the subject clearly in a few words, when you put your pupil to the study of Enfield's philosophy, or of either of the specific sciences, you put him to the study of a system of ultimate facts. Take from that pupil all the knowledge of facts which he has acquired, and you take from him all the philosophy, or all the science, which he has acquired. The same is true in religion. When you put your pupil to the study of religion, you put him to the study of those ultimate facts in his own constitution, in the constitution and course of surrounding nature, and in the bible, which constitutes the basis of religion, and the knowledge of which constitutes religious philosophy.

Hypotheses and theories are doubtless usefully employed in the service of religion, as well as in the service of other sciences, in instigating and guiding minds to the investigation and knowledge of facts ; but let them be ever understood and employed as such, and never receive the dignified appellation, or assume the important place, of religious philosophy.

Should any say that this is contending for little more than the uniform meaning and right use of terms, it is replied, that the misapprehension and misapplication of terms has led thousands astray from truth on the most important of subjects ; and on this very subject has been an occasion of endless controversy and confusion. While to others moreover, it has served as an apology for idle ignorance ; it being a less laborious task to deal out anathemas in round numbers against philosophy, than to become masters of it. But the time is come when in matters of religion, as well as in other matters, we must *think*—think profoundly and discriminate accurately—instead of talking at random against philosophy ; as though philosophy and religion were mortal enemies to each other. We must learn and teach, that not less real and certain

than the facts in material nature, are the facts in religion, — that the Deity has not intended and will not allow us to be wise men in other matters, and fools in religion, — that he has too much wisdom and benevolence to permit us to build our immortal hopes on dreams and shadows, — that he has placed religion upon the same everlasting foundation on which the pillars of the visible creation rest.

3. The pursuits of science and education in general ought to be conducted in reference to moral, not less than to intellectual improvement. Philosophy and duty equally dictate this. If it be a fact that we do possess constitutionally moral as well as intellectual powers, and do also possess intuitive moral knowledge as well as intuitive intellectual knowledge, with which to begin and pursue the business of education, then we cannot be true to our being, cannot improve the entire talent committed to us, acquitting ourselves as wise and faithful, unless we associate moral with intellectual cultivation, in the beginning and entire subsequent process of education. A very serious error has hitherto prevailed to a greater or less extent in this particular. The *moral* culture of childhood has been comparatively disregarded. Little has been done to early develope and bring into practical operation those principles in the moral constitution, which render us accountable, and are the first evidence of our immortality. Many and weighty reasons urge a thorough reform in this particular — many which fall without the present limits and design, and must therefore be here passed in silence — but the following suggestions are believed to be included in the general design of the present work.

No sooner does the child begin to observe and to think, than he begins to make moral distinctions. He begins to see that there is a right and a wrong, in human conduct; and his sensibilities are then tenderly alive on this subject. It is as natural to him to see and feel the difference between right and wrong, as to see and feel the difference between a friend and an enemy. Let this discrimination be encouraged. Let the law of moral duty, after which he is reaching, be clearly and

urgently addressed to his comprehension. Let his conscience be enlightened, his moral cooperate with his intellectual intuition, and all his intuitive knowledge be equally engaged in the business of his mental cultivation.

Another thing which the child intuitively knows as soon as he begins to think is, that he ought to do what he supposes to be right, and avoid doing what he supposes to be wrong. Let this knowledge — this sentiment of mor al obligation — be vigilantly nourished. Let a sacred regard to the dictates of enlightened conscience be inculcated as more precious than gold. Let it be made to appear to him as evident as his existence, which it easily can, that nothing in the universe is of so much value as a pure conscience. Let him see it to be that which no wealth can purchase, no penance procure, no pomp and glory command, — that it is also that without which there must be misery, and with which there must be happiness, even in the absence of all things else. It is as easy to teach the little child this, as it is to teach him his alphabet. And is it not as important? Does the spelling-book contain the whole of the child's first lesson? Ought he not to be taught his *moral* alphabet? and that too at the right age; before his mind is unduely pre-occupied — before other objects have engaged all its energies, and the moral sense is thrust back and lost, and wrong views are formed and wrong habits have become dominant?

Another thing which the child knows intuitively is, that he ought to do good to others — that he ought to act upon the benevolent and not the selfish principle. He does not indeed know extensively in what *way* he can best promote the happiness of others; this he needs to learn. But that he ought to endeavor to promote the happiness of others according to the knowledge and ability possessed, he knows as certainly as he knows that happiness is desirable. Now what is acting in obedience to this moral intuition but acting in obedience to the first law of heaven? — the law of HIM, who has given in himself the most perfect example of obedience to it, ever beheld. Let then all the motives tending to persuade the

child thus to do as he knows he ought to do, so many, so vast, so weighty, be timely and gradually unfolded to his view. Let him be faithfully and practically taught that all knowledge, fame, wealth, rank, are in the result valueless, without a benevolent character. Let him thus be encouraged to sacrifice every thing that comes in competition with this, — let one of his first and constant lessons be a lesson of self-sacrifice for the good of others. But is it not, on the contrary, a fact that most children are actually taught to be selfish ? Is not misguided parental fondness often more engaged to furnish materials and motives of self-indulgence, and to thus gratify and strengthen the naturally selfish feelings of the child's heart, than a wise benevolence is engaged to form in that heart a benevolent character, by giving early ascendency to a principle of action which the child intuitively knows to be right ?

Another thing which the child knows as soon as he begins to make moral distinctions is, that he is accountable for his conduct. Clearly he perceives this, and keenly he feels it, in the dawn of reason and first perception of a right and a wrong in conduct. This perception and this feeling ought to be as sacredly cherished and guarded as the apple of his eye. The truth ought to be continually present to his mind in bright and prominent aspect, that inasmuch as he is made capable of accountable conduct he will of course certainly be called to account; that every right and every wrong action is recorded on high, and is shaping his final destiny; that 'God will bring every work into judgment, with every secret thing, whether it be good or whether it be evil.'

Another thing which he knows intuitively is, that the limit of his ability is the limit of his duty. He knows that he *ought* to do what he *can* do, in the way of good to the universe. What is doing thus but obedience to the divine law ? 'Thou shalt love the Lord thy God with all thy heart, and with all thy soul, and with all thy mind, and with all thy strength' — that is, to the extent of ability ; or with all the powers possessed. This truth ought also to be sacredly cherished and diligently taught. It is important that the child be taught, just as his own conscience teaches him, that he is under obligation to do all

he can do; for anything short of this must be a defect in the character of a moral being. It is important that he be taught that nothing *more* is expected or demanded of him than what he can do; for this is so obvious to his reason and conscience, that to be taught otherwise will tend to beget scepticism in his mind in regard to the first principles of morality.

It were a pleasing task to expatiate largely on these first steps in the department of practical moral philosophy and education, and to illustrate their importance and feasibility in numerous particulars, but our limits do not allow it. It is hoped that the time is not distant, when other and abler pens will be engaged in this highly important but long neglected duty. It is no utopian project to respect the moral, equally with the intellectual intuitions of the youthful mind, in the business of its education; and the nature of dependence on divine blessings evinces both its necessity and its promise, in behalf of the rising and future generations.

By giving early due attention to all the constitutional powers and intuitive knowledge of the mind, and thus bringing it forward to maturity in the way which nature teaches, more correct and of course more uniform views may be expected to become hereafter prevalent on subjects of morality and religion. The course of mental cultivation has hitherto usually been, to first attend only to the intellectual knowledge — to thus urge the mind forward to a certain point, as it were compelling the child to walk on one foot, and see with one eye — till he has reached the age when he can be initiated into the peculiarities of a favorite sect; and thus, by a merely intellectual and mechanical process, form his religious creed.

Instead of this, let him from the beginning be taught to equally improve upon his moral and intellectual intuitions, let him from the beginning learn to walk on both feet and see clearly with both eyes, and at mature age he will walk erect and see things as they are. He will thus be introduced into the higher school of analogy, that world of knowledge, deep and wide, prepared intellectually and morally to expatiate therein with ever increasing wisdom and delight. Nature will interpret to him the bible, and the bible will interpret to him nature, and the identity and

divinity of their origin will become to him as apparent as the sun.

The equal perfection and extent of the two great laws by which the material and moral universe is governed, the natural law demanding passive obedience, and the moral law demanding active obedience, he will read in bright letters on every page of the visible universe. At every step of his progress in natural science, he finds increasing demonstration, that the material creation is governed by a uniform, wise, and perfect law. No chance, no hap hazard, but uniformity unbroken, wisdom divine, and perfection complete, wherever he turns a scientific eye. He sees this, in the wonderful mechanism of the human body, the perfect adaptation of all its parts to their intended purpose, and its entire fitness for the circumstances in which it was framed to live and act; he sees it, in the form, size, qualities, and uses, of the endless gradations of the animal and vegetable creation; he sees it, in the convenience of proportions, so accurately preserved in all the related parts of the material creation; he sees it, in the unvarying uniformity maintained in the order of physical sequencies for the convenience of provident man; so that, from calculations upon the future in regard to present surrounding objects, he may even ascend into the heavens, follow the planets in their lofty and rapid flights, predict their courses and positions for ages to come, and calculate distant eclipses.

Seeing thus how uniformly wise and perfect is that law which governs matter, and having his moral intuitions advanced to the same point, and equally clear, with his intellectual intuitions, he will instinctively and intuitively perceive the wisdom and perfection of that law which governs moral beings. Are not active minds as important to be governed as sluggish matter? Were not anarchy with them equally to be deprecated? Would the Deity reign in wisdom and perfection over his material universe, and would he not reign in equal wisdom and perfection over his moral universe? that part made 'in his own image,' stamped with immortality, destined to survive all time and all worlds. Sound philosophy and enlightened analogy answer, yes.

Not only the perfection, but the universality and extent of the claims of the moral law, he will also learn from the law of nature. Wherever he wanders in his observations through the material universe, he finds no portion of matter exhonerated from allegiance to that perfect law, which the Creator has impressed upon his works. Take one of its most well known demands — it is demonstrated that all material substances are attracted towards each other with a force directly as their magnitudes, and inversely as the squares of their distances. It was the demonstration of this fact, perhaps more than of any other, that immortalized the name of the most immortal philosopher. It was previously known that matter possesses a principle of repulsion and attraction, but the measure and universality of it were first demonstrated by Newton. It is now a commonly known fact, demonstrated beyond a doubt, that from the most ponderous globes in the skies down to the minutest portions of dust, and doubtless the minutest particles of solar light, this principle obtains with exact perfection. This is but one of the many ascertained examples, furnished by science, of the universal and exact homage demanded of the material creation to the law which the Creator has given it to obey. The scientific scholar now knows, that what was once considered the caprice of nature, the 'lusus naturæ' — is still her unvarying obedience to the same 'law of nature;' that whether he ascend with his telescope to make observation upon the heavenly bodies, or descend with his microscope to make observation upon the humblest portions of matter, in his whole progress from rolling worlds to floating atoms, he finds not a solitary exception. All the phenomena of nature, he finds to be a complete developement of the universal and complete administration of the God of nature.

What is his analogical inference? Evidently, that the law by which the intelligent creation is governed is no less universal in its demands — that it extends to all intelligent beings in the universe, and to all their accountable actions. Does the Creator exact universal and complete obedience to that law by which he governs his material kingdom, even down to the very mote? and is he

less concerned to demand universal and complete obedience to that law by which he governs his moral kingdom? Is he thus attentive to every particle of matter; and is he not equally attentive to every thought of the mind? Does he number the hairs of our head; and does he not also number the affections of our heart? — Are not the latter as important to him as the former?

With what clearness and certainty will the pupil of science, whose mind has been brought forward to equal points of maturity in intellectual and moral discipline, thus learn that there is a perfect moral law extending to everything in the moral world within him, not less than a perfect natural law extending to everything in the natural world without him. He will see that this righteous law leaves nothing pertaining to character unnoticed — that it enters all the remote springs of action, and all the secret chambers of the mind, laying an uncompromising claim to every moral affection and purpose there. As certain as is his knowledge, that there actually exists a moral as well as a material creation — intelligent mind as well as unintelligent matter — and that the former is at least equally as important as the latter, so certain is his knowledge, that he can no more rationally doubt the existence of laws over each equally perfect, universal, and adapted to their respective natures, than he can rationally question the identity of the God of the material and the God of the intelligent creation. And while he beholds the order, harmony, and beauty, prevailing throughout the material universe, by the entire passive obedience of all its parts to the law which they were made to obey, he will infer the order, beauty, and harmony, which would prevail throughout the moral universe, by the entire active obedience of all its subjects to the law which they were made to obey. Nor will it militate at all in his mind against the absolute intrinsic perfection of the moral law, and the extent of its demands, that multitudes do not obey it; for the fact that voluntary agents do not act wisely on their part, is no evidence that the Creator has not done wisely on his; — and the only point where the analogy in respect to the government of matter and of mind fails is, that in the one

obedience is in its nature, involuntary and irresistible, and in the other it is in its nature voluntary and may be withheld. Wherever moral beings are true to their duty and *do* obey their law, as perfectly and universally as matter obeys its law, it is heaven.

Having thus obtained thorough and exact views respecting the great central law of morality, his mind will naturally go out correctly into all its specific branches. The whole subject will open to his view in a luminous world of grandeur, simplicity, and beauty; every fact on the face of nature will throw light on some page of the bible, and every fact on the face of the bible will throw light on some page of nature. The more thoroughly he studies and understands the facts in nature, the more rational and strong is his conviction, that the Being who framed and who controls the universe inspired the bible; the more thoroughly he studies and understands the facts in the bible, the more they commend themselves to his conscience; and the more he obeys his conscience, thus enlightened by the moral law, the more he finds of that promised 'peace' — the sovereign and supreme good of the immortal mind. In this way natural science will aid morality, and moral science will aid the study of nature; — sound philosophy and sound character will advance together; science and religion will join hands, and their espousals will be celebrated in a millennial jubilee. For it cannot be too much to expect, that from beginning with the elements of all knowledge, advancing thence intellectually and morally, correctly studying and practically applying generic principles, and thus coming forward to maturity from the point, and in the manner and direction indicated by nature, correct views respecting the great principles of morality, as well as of science, will naturally result; and when this shall be done universally, correct and uniform views respecting the essential truths of religion will universally prevail, and the day of which prophets have taught and poets sung so long, will dawn on the world.

The influence of prevailing views of morality thus firmly founded in the philosophy of the human mind, and of prevailing character formed thereon by an early right

developement and use of the moral powers and intuitions, must be highly auspicious to all the subsequent temporal interests and eternal benefits of sound practical science, as well as religion. The first and most obvious proof of this, is the known ascendency of the moral character of the mind over all its intellectual springs and energies. Purity of character and energy of intellect have a strong natural affiance: so have vicious character and mental imbecility. Individual examples of distinction in science associated with vicious character, furnish no exception to this remark, for the career of such is short, soon terminating in the prostration and sacrifice of intellect at the shrine of sensual indulgence; and even while the brief day of their fame continues, it subsists on acquisitions made before they began to sink under the enervating influence of vice, and on what is procured to them by the community in which they live. Such there are in every community who subsist, like swine in a garden of fruit, upon the productions of the virtuous industry of others, not less stupid and ungrateful. But it is the uniquevocal testimony of all time and all experience, that so indissoluble is the connexion between moral obliquity and intellectual degradation, that no community can long sustain an eminence in science, without the inspiring and elevating influence of a pure religion on its character. Consequently, the universal and strong ascendency of such a religion on the minds of men — whatever in it tends to purify and exalt character — whatever imparts to the thinking spirit dominion over 'the lusts of the flesh, the lusts of the eye, and the pride of life' — whatever breaks from the mind the fetters of sin, and gives it to ascend and expatiate freely amid the works of God — must greatly accelerate the progress of the world in science and philosophy.

The keen and ever living interest which the mind feels in its intellectual perceptions, when its moral energies are elevated to the same point of perception, operates also as a direct powerful stimulus to constant effort in pursuit of knowledge. Nothing else is so effective to hold the restless mind in a state of fixed unwearied tension — nothing so strong to chain down its scattering thoughts

and wandering imaginations, to concentrated intense action on great and sober verities. It is only when the heart goes with the intellect, that the intellect plies with all its might, steadily and forever. The fire of ambition may burn, and stimulate the intellect for a season against the strong current of sensuality; but it is only a fire kindled from the altars of a higher and purer world, the hallowed fire of a feeling in love with the works and ways of God, guiding, controlling, impelling the mind, that will burn forever, and ensure increasing progress in its science of God and nature. It is when refined of earthly alloys, quickened, energized, by holy fire, that it brings to the patient study of nature's great book such a tone of interest, and clearness of vision, as renders every successive page bright with meaning, and glowing with interest. Nothing is then contemplated by it in vain; for, every object in nature, from the least to the greatest — from the meanest to the grandest — from even the humblest 'reptile that creepeth on the earth,' through all the ascending grades of organic life, 'the beasts of the field, the fowls of the air, and the fish of the sea, and whatsoever passeth through the paths of the sea,' in every mountain, valley, forest, and clime; every ocean and river, teeming with their endless gradations of happy, useful life, — also every developement of divine energy and intelligence, impressing their laws on unorganized matter, from atoms to worlds, and from worlds to systems of worlds, — also every ascending grade of the vegetable kingdom, almost a kingdom without end, from the feblest blade of grass, or the puny plant, to the towering and ancient oak waving its proud head in the forest, — also every exhibition of taste and splendor, from the smiling flower that blooms on the mountain, or unfolds its modest beauty in the valley, to the magnificent display of stars and suns that sparkle and blaze in the skies — all reflect the image, and with various but harmonious voice proclaim the glory and sing the praise of God. Under such an inspiration, how can the intellect be otherwise than ever bright, active, advancing?

There is moreover a philosophy living quite above the objects of time and material nature, in a higher and

more ample field of being. To this the mind is introduced, only by the previous moral culture herein commended. Without this, even the strongest and most gifted mind cannot advance a step, in lucid knowledge, beyond the circumference of time and visible things. It may revolve round with the earth in its orbit; it may watch the stars in their courses; it may gaze with admiration upon various exhibitions of material phenomena; it may pass with rapid flight to and fro through the narrow circles of time; but all beyond is dark as midnight! *a dead blank!* How stinted the philosophy of such a mind! Now it is a known law of mind, that it tends to contract to the littleness, or expand to the greatness, of the objects of its contemplation. But transcendently the most sublime and magnificent objects of contemplation are contained in that divine philosophy, to which reference is here had. Herein it is, that the true dignity and value of the mind are recognised, the high end of its being seen, and the momentous facts pertaining to its immortality and accountability propounded, as by a voice from heaven; it here passes the bounds of time and the grave, ascends into the regions of immortality, expatiates in the calm bright worlds of spiritual being, discovers thrones and kingdoms on high, walks with higher and yet higher orders of intelligence, aspiring to their greatness and panting for their employments. If then the design of philosophy be to enlarge the mind and acquaint it with important facts, and if the purest happiness of man be of a mental rather than a sensual kind, where else in the wide range of thought do we find discipline so salutary, or sources of present happiness so abundant?

But it were an injustice to the better sense and feelings of the intelligent reader, to stop the argument here. The immortal mind is in this world passing through the scene of its probation and pupilage, which is shaping its destiny for the ever expanding circles of eternity. Dust our bodies indeed are, and unto dust they must return; but our living spirits, of higher birth and higher destiny, shall return to the God who gave them. But they will return to him not *as* he gave them; they will return to him possessed of *character* — a character such as his right-

eous government approves or condemns. To cultivate the intellectual to the neglect of the moral talent, which heaven has committed to our trust — to make valuable attainments in the philosophy of intellect, but not in the philosophy of character — is to then come short of the desired object of this life, and press our way into eternity unprepared; to encounter the burning eye of our final Judge, who in righteousness will say, 'Cast ye the unprofitable servant into outer darkness.' Why then should immortal philosophy, on any pretence, be so often compelled to gather nothing in her ample folds but destruction and death? Why be restricted to the objects of the present world, when the seeds of mortality are in them, and they are all so soon to perish forever from our presence? Rather let her regard all attainments in intellectual science, as subserving the higher attainments of character, qualifying its subjects for a happy eternity. Let her stand upon the dust of every grave, commingling the pure lights of science and revelation, and pointing immortal minds to their home in the skies. More than this, let her complete her begun work, and conduct us in prospect quite through the mighty sweep of events involved in the history and end of time, reanimating before us the dust of all the dead, and proclaiming victory over the grave itself; still pouring her splendid visions upon us, till the illumined eye, itself bright and kindling, clearly descries the new heaven and new earth, rising phœnix like from the ashes of the old, wherein dwelleth righteousness.

It will be done. All the attainments of science and philosophy, are destined to ultimately subserve, the ever living and growing empire of God; all their lights are yet to concentrate, and burn, and blaze, along the path of the eternal mind.

SCIENTIFIC TRACTS.

VOL. II......NO. XIV.

ASSOCIATION OF IDEAS.

We have not very often called the attention of our readers to subjects connected with the science of Intellectual Philosophy. It is however our design occasionally to do this, not for the purpose of presenting in these pages detailed and systematic view of the Philosophy of the Human Mind, but of exhibiting popular views of such detached topics, as may most easily be turned to practical use in the business of life.

Intellectual Philosophers have often involved themselves in endless perplexity in their endeavors to understand what the human mind is *in its essence.* We are conscious of its *operations*, and of these alone. For example, we all know what it is to *remember* or to *hope*, —but when we look within us, and try to grasp and to hold in view the very agent that does this, we are baffled. If a bell rings, we can perceive both the *ringing* and the *bell;* i. e. we can distinctly conceive of *the bell* as something entirely distinct from *the ringing*. If however *a mind thinks*, we can understand the *thinking* but not the mind as distinct from it. The *operations* only of that thinking and feeling principle within us, come under the cognizance of our consciousness, and these are consequently all which are the proper subjects of philosophical inquiry.*

* If any of the readers of this tract are accustomed to metaphysical inquiries, they will perceive that the illustration of the

Among the most obvious of the laws of these operations of the human mind are those which are classed by intellectual philosophers under the name, Association of Ideas; by which is meant such a connexion between the various thoughts of our minds, that one tends to introduce another.

This may be illustrated in a great variety of ways. A young man, we will imagine, walking in the country, sees a tree whose topmost branches are split and broken, evidently by some uncommon violence. He immediately thinks it probable that it was done by lightning. He then thinks of a house which was struck a few days since, and his imagination paints to him the appearances which the rooms exhibited as he passed through them, the day after the disaster. He then thinks of the expense of the repairs necessary, and recollects that the poor widow whose dwelling was thus injured, is but little able to sustain this additional demand upon her slender means. The case of others who are destitute arise to his view, — the sick man whose chamber he visited a few days before, and some conversation which he had at his bedside rises to his recollection. Thus in his reverie he is insensibly carried entirely away from the original object, — the broken tree, — which started this current of thought. But though he has been carried entirely away, it has been by successive steps, in each one of which there was a natural connexion between the preceding and succeeding thought. It might puzzle him much, after the intermediate parts of the series had been forgotten, to understand how a tree rent asunder by the lightning, could have suggested to him a conversation at a sick man's bedside. If however the intermediate steps are remembered, it is very easily accounted for.

The train of thought suggested to different minds by the same object is very different. For example, in the case which we have above supposed, another man, see-

bell is only used to convey a distinct idea of the difference between the properties and the essence of an object. Strictly speaking, as might easily be shown, we know no more of the bell than of the mind. The effects or properties of an unknown essence are all which we can see in either case.

ing the broken top of the tree in the forest, might have been reminded by it of the violence of the *wind*, instead of the power of lightning. His thoughts might have gone off consequently in a very different direction — storms at sea, — shipwrecks, — the construction of ships, —the nature and comparative strength of different sorts of timber, — might have been the steps of the series through which his mind would have wandered ; and thus the two, setting out from the same point, might have pursued a very different course, and arrived at very different results.

Every one of the readers of these pages will, by an examination of their own trains of thought, notice the law of mind to which we have been adverting. Nothing is more common than for a person to observe this when reading. Something stated on the page of a book in which the reader is not very strongly interested, awakens a train of thought which occupies his mind for many minutes, and after a short time he perceives that his eye has perhaps passed over several paragraphs, without his receiving any idea of their meaning. He finds perhaps that he is thinking of something which has apparently not the remotest connexion with anything which his book has presented. If however in such a case the train of thought should be traced back, it will usually be found to have been originally started by something which the book contained.

Or the experiment may be tried in the following way: Sometime when the reader is alone, walking by himself, or sitting alone, in a reverie, let him arrest himself by the question, 'What am I thinking about?' Then, 'What led me to think of this subject?' If now, the train of thought is examined in this manner, going back from the thought first noticed, it will often be found that the series may be unravelled to a great distance, and the nature of this law of mind may be very clearly understood.

The question very naturally arises, what is the nature of the connexion between one idea and another as they are thus linked together. This question has very often been discussed, and various principles of association have been

presented by the different writers on this subject. We shall mention such as occur to us.

1. *Similarity*. The sight of one thing calls to the mind something similar which has been seen before. A common instance of this is a portrait, calling distinctly to our minds the individual whom it represents. In fact it is the very object of portrait painting to take advantage of this law of our minds, and by means of something similar to the object of our affection, to call to our minds more distinctly, than can in any other way be done, a vivid conception of the objec itself.

A traveller was once passing in the steam-boat from New York to Providence, and was sleeping at midnight as quietly as it is possible to sleep in the jarred and trembling berth, when he was awaked by some unusual sensation. He opened his eyes, and he listened, and soon perceived that *silence* was the strange, unusual circumstance which had awakened him. The engine had stopped. He could feel that the motion of the boat was gradually diminishing; and instead of the loud rumbling of the machinery, he could now hear nothing but the faint washing of the waves upon the plank which was at his ear. He groped his way out of his berth,— and by the dim light of a solitary lamp which was burning at the remote end of the long cabin, he found his way among the settees covered with sleepers, which almost filled the floor, and passed up the stairs and stood upon the deck. It was a fog. An eastern wind had blown strongly during the night, and the Captain thought it safe to stop the way of his boat in order to sound. Several other passengers not much accustomed to the the slight hazards of a steam-boat passage, had been aroused by the same circumstances, and they took their seats in a sort of saloon erected upon the upper deck, where they spent the hour or two which remained before break of day in conversation.

Now we presume that there are very few of our readers, however little they may have studied Intellectual Philosophy as a technical science, who know so little of human nature as not to be able to predict with almost

perfect certainty, upon what subject the conversation of these voyagers will turn. One idea suggests its like. To be placed in peculiar circumstances of any kind suggests to those in it, other cases similar in character.

It was so in this instance. 'A short time ago,' says one, I was passing through the sound in the fall of the year, and the fog was so dense that we could scarcely see the length of the boat. A man was stationed as far forward as possible, watching for land, and as soon as he discovered it, we renewed the motion of the engine and backed off. Sometimes we proceeded for miles by the guide of the lead alone; — and once we were so near the shore that we heard a bird singing in the grove and were warned by her music not to approach. The engine was stopped immediately, but the momentum of the boat carried us forward till we came in sight of the grove whose tenant had so kindly sounded the alarm.'

Another related a story contained in a book of travels by Capt. Hall. In order to avoid the danger arising from the dense fogs off Halifax, a cannon was placed at a lighthouse on an island there, to be fired as a signal to any ship which might be coming in; — the ship and the lighthouse to fire alternately. It so happened at one time that two ships were coming in together, and each mistook the other's fire for the signal which was to guide her in. Both were conseqently deceived, and one run upon the rocks and was lost.

A third related some adventures which he had met with on the North River in a time of danger in a steam-boat — and thus every one had some case of danger or delay, brought to his mind, similar to the one which had attracted their attention that night and aroused them from their slumbers. And so strong was this disposition to bring again and again to view similar scenes of danger and difficulty, that if some one of the company more philosophical than the rest, had seen that this was not exactly the best or the pleasantest topic of conversation at such a time, and had made an effort to introduce more cheerful and agreeable subjects, he would probably have failed altogether. They might have been turned away for a mo-

ment, but while sitting in that saloon by the dim light of the solitary lantern, and with the whistling wind and the impenetrable fog all around them, so strong must have been the influence of such a scene, and so great the power of the principle of association we are considering, that in all probability the conversation would have returned again and again, instinctively, to the narrations of difficulties and disasters at sea.

The reader will at once perceive that illustrations of this principle might be easily furnished in great numbers. The sight of a mountain or a waterfall reminds the traveller of some similar mountain or waterfall which he has seen before; and the countenance of a stranger, seen in a crowd in a foreign city, will often bring forcibly to our minds, by an accidental resemblance, a friend whom we have left at home.

This *similarity*, which is thus the foundation of the connexion by which one idea suggests another, may assume various forms; that is, ideas may be linked together in various ways, so that the same object will awaken in the minds of different individuals very different trains of thought, all however connected by the principle of similarity. For example, if a watch is held up to the view of various individuals, it suggests various thoughts. A child will think of a toy-watch which his father had brought him. A sea-captain will be reminded of his chronometer, and the classical scholar of the great superiority of this modern instrument over the ancient clepsydra, an image of which will arise to his view. Thus the thoughts of each individual may be led off in a different direction, and yet each suggested idea may be brought to view by some point of resemblance to the object seen by all.

Contrast is sometimes said to be a principle of association. For example, a very cold day in winter will remind us of a very warm day in summer. A very tall man will bring to our recollection a dwarf. It seems to us however that it is *resemblance*, or *similarity*, and not contrast, which connects the two ideas together in such a case. 'But in what way,' the reader will ask, 'can

the two thoughts be said to resemble each other in such a case?' We answer, in the circumstance that *they are remarkable.* A man for example goes into a museum, and sees a dwarf, less than three feet high, attracting general attention, and awakening universal surprise. A crowd are around the keeper, asking many questions about his history, his habits and his occupation. A few years after, the same individual is present at the exhibition of a man of a very different appearance. He is of a gigantic stature. But though the two qualities which excite curiosity, seem to be entirely opposite, there are many respects in which the two cases are similar. The giant and the dwarf are *similar* in being uncommon examples of the growth of the human body. They are similar in the circumstances of being exhibited, of attracting general attention, of giving occasion to a multitude of questions, — and in fact in various other respects. Now it is highly probable that it is *these circumstances of similarity*, which give power in the one idea to bring up the other. The association between the two is probably founded upon the respects in which they agree, and not upon those in which they differ.

In the same manner a very cold day in winter will bring to our minds one of extraordinary heat in summer. But the probability is that it is the extraordinariness, in which the two agree, which establishes the connexion between them, and not the contrast as to temperature, in which respect they differ.

2. *Cause and effect.* This is another very important principle of suggestion. When we see an effect we are reminded of its cause, and conversely in seeing a cause our thoughts are often immediately carried forward to the effect. A man stands upon the bank of a river and is watching the waters as they flow smoothly and uninterruptedly by. He gazes for a few minutes upon the beautiful transparency of the stream, and he gradually loses himself in a reverie. He sits down upon the green turf which carpets the bank, and wanders in imagination far up the winding course of the water. He fancies branch after branch pouring their tributaries into the current which swells as it flows, and at last he has arrived, in im-

agination, at the fountain, and can see, almost with the distinctness of actual vision, the small rivulet issuing from a marsh, or the fountain bubbling unceasingly in the bosom of some distant forest. His thoughts then explore the means of supply for the marsh or for the fountain. He thinks of the rain, — of the floating clouds, — of the evaporation from the ocean, and of the heat of the summer's sun. He thus goes back, step by step, from the effect before him, to the remotest cause which his intellect can explore.

His companion perhaps sitting by his side, indulges in another train of reflections, similar in principle but different in every step of its progress. He goes *down* the stream — his mind passes from causes to effects, for the water passing the spot where they are sitting, though it may be considered as the effect of what is above, is the cause of the appearances which are exhibited below. In his reverie then, he follows the stream in its downward course, endeavors to form a clear conception of the appearance of the country through which it passes, and of the various turns in its course, as it winds its way to the ocean. He thinks of the populous town which has arisen upon its banks, and which may properly be considered as an effect of the stream,—of the widening and deepening of the current, as it advances towards its mouth, — and he paints to his imagination the view which is presented at last, where the banks of the stream recede from each other, and pass into the shores of the great bay, in which the waters of the river mingle with the waves of the ocean.

This principle of association cannot be confounded with the last mentioned. It is not *similarity*, it is *cause and effect*. We see a plant growing and inquire what sort of a seed it sprung from, — not because the seed is similar to the plant, but because it is the origin of it. We see an ingenious piece of of mechanism, and immediately ask who made it. The mind in such cases runs back instinctively to the cause. In other cases we look at the effect. A ship of an entirely new form and construction has been built, and a crowd are collected around her upon the wharf. Now what is the thought which in such a case will be present to every mind? Why simply the

inquiry, 'How will she sail? What will be the *effect* of this construction? Will it answer the purpose intended?'

In young children this example of association is perhaps stronger than any other, and it shows itself in a very interesting manner in the thousand questions which they are unceasingly asking, about the *origin* and *cause* of everything they see. Who made this, and who made that? Where did this book come from? Who planted that tree? &c, &c, are the questions they are continually asking. It is a very wise arrangement of Providence which has established this law of their minds, for it is more effectual than anything else could be in accelerating their progress, in acquiring a knowledge of the world, of new objects in which they find themselves placed.

3. For the third principle of association which we shall describe, it is very difficult to find a name. When two objects have once been together before the mind,—however dissimilar they may be, and however little connexion or relation between them there may be, one will almost always bring up the other. For example, a man far away from home, sees a countenance, as he is walking in the streets of the foreign city, which he recollects to have often seen perhaps in his own native town. Now how vividly in such a case will his home, and all the scenes and the friends he has left, be called up to his mind, simply by seeing an object which he has been accustomed to see in connexion with them! A son who has by his dutiful and obedient conduct, strongly bound to him the hearts of his father and mother leaves at last his home, to reside for a time at some distant literary institution, or to make a voyage to a foreign land. They bid him farewell in the morning, and the various duties and occupations of the day, keep the sad thoughts of their long separation away from the parents' hearts. But when evening comes, and they gather around the tea-table, the mother looks upon his vacant seat and sighs. That chair and that place have so often been filled by her son, that the connexion has become strongly established, and she cannot see it without being forcibly reminded of her temporary loss.

Or to take a case more affecting than this, but which is in substance exceedingly common. A child is sick.

It is of such an age as to entwine itself strongly around the affections of its parents, and they watch over the cradle with unremitted care. Day after day of anxious attention, and repeated nights of sleepless solicitude do not exhaust them, but all is in vain. They have in a few days to follow the little one to his long home.

Months pass away, and time has almost healed the deep wound which this providence has inflicted. At last, one day while the mother is busy in her various household cares, — thinking not of the one who is irrecoverably gone, but of the many who are still spared to her, — she finds, in some remote drawer, which had not for a long time been disturbed, a plaything — the favorite book or toy of her lost child. She had seen him with it a hundred times, she had witnessed with pleasure the childish delight which it gave him, and heard the many questions to which it gave rise, and now she stops suddenly when the long forgotten toy comes again to her view. She gazes at it intently for a moment and the tear gushes from her eye.

Now the principle of association in such a case is evidently this. The mother has seen the child and the toy often *together*, before, and the sight of the one immediately brings the other to view.

This is perhaps not the most frequent but it is certainly the strongest of the principles of suggestion we have named. It is by this that the *sound* of a word is brought to our minds when we see it written upon a page. Children are taught their letters by it. We show them the letter *o* printed in a book, and we make the sound *o* at the same time. There is nothing in the appearance of that small circle to suggest that sound. The letter is pointed out again, and the sound made again, until at last the two have been presented together to the mind of the child so frequently, that the connexion has become established. Then we try to ascertain whether one will call up the other by showing the child the form and asking him for the sound; i. e. we show him the letter and ask him what the name of it is. In the same manner, the connexion between the appearance and the sound of all the letters is established, simply by *presenting them together*, again and again to the child. After a time this

connexion, and the association arising from it, becomes so strong that we almost forget it is wholly artificial, and that the character *o* would be just as suitable to designate the hissing sound represented by the curved line *s*, as that curved line is. Probably nine children out of ten, who have been for some years accustomed to reading, imagine that there is something in the very form of the *s* which adapts it to its purpose of representing the hissing sound, and that no other letter of the alphabet is so suitable. Whereas it is very evident from the fact that sometimes *c* as in *cent* represents this hissing sound, and that in oriental languages a different character altogether, which we cannot conveniently represent, for want of type, is used to denote this very sound, that there is no natural or necessary connexion at all between a crooked mark and a hissing noise. It is all the result of an accidental association. The sound and the letter are often together in the mind, and one consequently at last will always call up the other.

In the same manner the form and position of the *notes in music*, suggest the length and the pitch of the sounds which they denote, and after the performer has, by long practice, habituated himself to this association, he comes at last to imagine that there is something in the form of a semibreve which naturally suggests the idea of a long note, and that a short one is expressed just as naturally by the demisemiquaver; whereas one who had never seen a music book most certainly could not tell, by inspection of these characters, which was intended to designate a note of the greatest length.

These casual associations, between objects which have no natural connexion, become in many cases so strong, that it is difficult if not impossible to separate them. It is very difficult for a mind not accustomed to reflection to see clearly that words, for instance, have no natural tendency to indicate the thing signified. The word black, for example, is in itself no more appropriate to represent the color of *coal*, than it is the color of *snow*. It is only because we are so accustomed to its use in the former sense, that we are inclined to think that it is. To many persons this is so obvious that they may per-

haps be surprised to see it stated and illustrated so formally here. To others however, less accustomed to such speculation, it may be very reluctantly admitted. There is no question however of its truth. If a foreigner, who was acquainted with none of the words of our language, were to be shown the two colors, and to be told that one was called black and the other white, he could not possibly tell in what way these names were applied; unless perhaps he were a Frenchman, and should say that *black* was the name given to the color of the *snow*, because the corresponding word in his own language, *blanc*, is similar in sound. So with all language. The word *six* might have been as properly used to signify a single object as to designate many; and *horrid* might have been employed to denote the most delicate and alluring beauty. It is only our having been habituated for so long a time to the present meanings of our words which leads us to think otherwise.

We wish that the reader would notice particularly, that this species of association comes strictly under the fourth principle which we are now considering; that is, the principle that when two objects have been repeatedly together in the mind, the one will always afterwards readily call up the other. The way in which the meanings of words become so strongly associated with the sound of them is this. We will take the word *sweet*. A child receives some sugar, and while eating it the mother tells him it is *sweet*. The taste upon the tongue and the sound in the ear come together to his notice. A short time after the child is eating an apple and hears the same name applied, and thus the connexion between the word and the idea is strengthened by numerous repetitions, and as the individual passes on through childhood and youth, the connexion becomes so firmly established as to defy all attempts to separate again what was at first only accidentally joined.

I have said this was the case with all the words of our language. Perhaps this remark ought to be made with some slight qualification, for there are some words which seem to possess some slight natural adaptedness to represent their meanings. Such words as *hiss*, *rattle*, *clap*

thunder, &c, seems to be slightly connected with the ideas which they respectively represent by the *first* of the principles which we described, viz. *similarity*, for in such cases there is a slight similarity between the sound of the words and the peculiar noise which it is intended to represent. With the exception of a small number belonging to this class, the whole mass of the words of our own and of every other language are connected with their respective meanings, simply by the accidental circumstance of both having been brought before the mind together.

Although it is very plain in the cases we have described, that this casual association is really all which connects a word with its meaning, there are some cases where it is difficult to tell whether previous co-existence in the mind is or is not the whole bond by which two ideas are united. Consider, for example, the high and low notes in music. The acute sounds, as our readers are undoubtedly all aware, are called *high*, and are written upon the higher lines of the staff, and the graver notes are written below. Now it has been made quite a question, whether there is in nature any foundation for this distinction. Might not this arrangement have been reversed, so that what are now the higher notes might have been written lowest and called lowest, or is there some similarity between a high *sound* and a high *position* upon the paper?

The effect produced upon the mind by different kinds of music depends to a very great degree upon association, though perhaps not altogether. There is something perhaps in the very nature of martial music, for example, its quick and regularly measured movement, which is adapted naturally to awaken the animating emotions to which it gives rise. Children are excited and delighted with it, the first time they listen to its sounds. It unquestionably however awakens very different emotion in the breast of a child who knows it only as a signal of a holiday, and in the heart of an old soldier who has again and again heard it mingling with the shrieks and groans of a field of battle.

The principle of association which we are considering, is the chief link by which the words and phrases of any

thing committed to memory, are connected in the mind. Take for example the letters of the alphabet. We have had so often the letter *b* in our minds immediately after the letter *a*, that when the latter is suggested to us, the former comes immediately as a matter of course. The letter *b*, on the same principle and in the same manner, suggests *c*, and so on through the alphabet. If we try to reverse this process, we shall fail. No one without considerable previous practice can repeat the alphabet backwards. If any of our readers should try the experiment they will find that they cannot do it without pausing to think, and upon noticing carefully the steps, they will observe that they will continually go up the alphabet to a higher letter, and then run down until they come to the one next above the one last spoken. Thus, if we represent the letter spoken by capitals, and those only run over mentally by roman characters, saying the alphabet backwards will generally go thus: Z, w, x, y, z. Y, *w*, v, w, x, X, and so on; the experimenter striking into the alphabet far above the place, and then running down according to the natural order of the *previous connexion* of these letters in the mind, until he comes down to the one next above the one last named. This experiment shows in a very interesting manner, not only that of objects previously connected in the mind one will suggest the other, but that this suggestion will only take place in the order of the previous connexion.

A traveller in a distant country often feels the power of the principle of association we are now describing, when he sees some object which reminds him strongly of home. A case is often mentioned in the books on this subject, which we here quote. It is an extract from the journal of an English sea-captain when far away from home.

'While we were at dinner in this miserable hut, on the banks of the river Dwatska, and the guests of a people with whose existence we had before been scarcely acquainted, and at the extremity of the habitable globe, a solitary half worn, pewter-spoon, whose shape was familiar to us, attracted our attention; and on examination, we found it stamped on the back with the word, London. I cannot pass over this circumstance in si-

lence out of gratitude for the many pleasant thoughts, the anxious hopes, and tender remembrances it excited in us. Those who have experienced the effects, that long absence; and extreme distance from their native country produce in the mind, will readily conceive the pleasure such a trifling incident can give.'

The following are two other examples which strikingly illustrate this part of our subject.

'It is related in one of the published lectures of Dr Rush, that an old native of Africa was permitted by his master, a number of years since, to go from home in order to see a lion that was conducted as a show through the state of New Jersey. He no sooner saw him than he was so transported with joy, as to express his emotions by jumping, dancing, and loud acclamations, notwithstanding the torpid habits of mind and body, superinduced by half a century of slavery. He had known that animal, when a boy in his native country, and the sight of him suddenly revived the memory of his early enjoyments, his native land, his home, his associates and his freedom.'

There is by the same writer another interesting instance of the power of association, in which he himself had a part, and which will be given in his own words. —'During the time I passed at a country school, in Cecil county, in Maryland, I often went on a holiday, with my schoolmates, to see an eagle's nest upon the summit of a dead tree in the neighborhood of the school, during the time of incubation of that bird. The daughter of the farmer, in whose field this tree stood, and with whom I became acquainted, married, and settled in this city about forty years ago. In our occasional interviews, we now and then spake of the innocent haunts and rural pleasures of our youth, and among other things, of the eagle's nest in her father's field. A few years ago, I was called to visit this woman when she was in the lowest stage of a typhus fever. Upon entering her room, I caught her eye, and with a tone of voice said only "the eagle's nest." She seized my hand without being able to speak and discovered strong emotions of pleasure in her countenance probably from a sudden association of all

her early domestic connections and enjoyments with the words I had uttered. From that time she began to recover. She is now living and seldom fails to salute me with the echo of the "eagle's nest."' *

The three principles which we have thus detailed and illustrated are perhaps the most important of the principles of association. There are in the various treatises on intellectual philosophy which are before the public, some others which may perhaps however be resolved into these. We shall present no other here, but shall occupy the remaining pages of this tract in laying before our readers some of the consequences which follow from the mental law which we have thus detailed, and some general considerations which the subject presents.

1. *Habits of Association.* As one of the most important of the principles of suggestion depends upon the past connexion of thoughts in our minds, it is plain that the whole past history and manner of life of every individual will strongly influence his trains of thought. Two men who have been in different scenes and engaged in different pursuits will have very different trains of thoughts suggested by the same occurrence. For example we will suppose that a lawyer, a trader, a physician and a clergyman, passing along a street and observing a crowd collecting, approach the spot and find that two men are quarrelling. They stop a moment and have just time to see the nature of the transaction before the men are parted by the bystanders, and then they pass on, each his own way. There is, we will suppose, a distinct impression upon the minds of all, of the whole scene,—the infuriated looks of the combatants,—the malignant spirit with which they inflicted the blows, and with which they eagerly endeavored to continue the contest,—and the blood which had begun to flow. Now all the spectators see the same thing, but how different will be the trains of thought awakened in the minds of the different individuals.

*Upham's Text Book.

'It is a decided breach of the peace,' says the lawyer to himself, 'the police ought to interfere. There were witnesses enough, and there was violence enough to subject them to a severe sentence.' He then falls into a reverie, in regard to the manner in which the case would be treated in court — the plea that could be made, — the punishment which the judge would assign, — and perhaps similar cases, in which he had himself been engaged either for plaintiff or defendant, would come up to view.

'That wound,' thinks the physician, 'under the eye was not of much consequence, but I observed a contusion upon the temple of one of the men which I should think might give him some trouble. I should not suppose it could have been given by the fist. It reminds me of the wound upon the head of a man who was murdered, and whom I was called upon to visit the other day.'

The trader has another train of thought. Accustomed to the employment of men in his business, and acquainted with the circumstances of their families, he speculates upon the idleness or the intemperance which probably led to such a melancholy occurrence, and upon the unhappy condition of a family of which such men are at the head.

'What a melancholy exhibition of human conduct, is this,' says the clergyman to himself, as he walks thoughtfully away. 'When will men obey the great golden rule, and love each other as they love themselves?'

Thus the train of thought in each mind is modified, and in fact characterised, entirely by the past habits of the individual observer, and this not only so in a striking occurrence like this, but in regard to all the common circumstances of life. Hold up anything extraordinary in the view of half a dozen persons, and after a pause of a minute or two, ask each one to describe the train of thought which it suggested to his mind. This is an experiment which any one can very easily try in his own family, and wherever it is tried, it will be attended with interesting results. Or, instead of purposely bringing forward some object, to observe the effect which the sight of it produces upon different minds, the experi-

menter may watch an opportunity when several persons are thoughtfully and silently observing some object or scene, and then suddenly ask each one of the company to describe his thoughts.

2. *The Influence of Associations upon our opinions.* A volume instead of a few paragraphs might be written upon this subject, and if properly written it would produce a greater effect in removing prejudice and softening the asperities which difference of opinion so often occasions, than almost anything besides. Casual associations often enhance the value of an object, and they often destroy its value. They very often also, by being of an opposite nature in different minds, produce a difference of opinion on the same subject, making the individuals themselves wonder exceedingly why they do not agree.

They *often enhance the value of an object.* That is, they give it an accidental value, which it does not intrinsically possess. The common case of a present from a beloved friend is an apt illustration of this. The thing presented becomes, on both the second and third of the principles named above, so closely associated with the idea of the friend, that it always calls him up to mind. It has therefore a power to give pleasure to the possessor which it cannot give to any one else, and which no similar object of equal intrinsic value can give him.

A man becomes strongly attached to the estate which he has inherited from his ancestors, so as to value it far more than he would one worth perhaps much more to a person who should have no peculiar associations connected with either of them. In the same manner the desk at which we have long written, the tool or the instrument which we have long used, the Bible which we have been accustomed for many years to read, — all become loaded with associations which cluster around them, and though they are invisible to every eye but that of the owner, they are real and most valuable to him.

Again. *Accidental associations often very much diminish the value of objects.* They make us dislike, what without them, we should look upon with pleasure or at least with indifference. A common instance of this is

furnished by the dislike which most persons have to the sight of surgical instruments, especially if they have ever suffered by them. The sight of the instrument becomes so connected with the recollection of the suffering, that the one brings up the other to the mind.

Most *antipathies*, as they are called, arise from this source. A young child was once playing in the grass and was suddenly very much frightened by the sight of a snake. The impression made was so strong, that ever afterwards the sight of a snake, or even the picture of one, would bring up the same agony of terror. The degree of alarm and suffering which was occasioned to that individual, after he had arrived at the age of eighteen, by simply forcing upon his view a picture of a serpent, would appear incredible to one who had not particularly noticed the power and the permanency of such early associations. Parents ought to be aware of this principle of the human mind, and not expose their children in early life to impressions which they may labor for years in vain to efface.

It is very often the case that an object, in itself valuable, may, by being connected with some unpleasant association, be actually nothing but a source of pain. For example, suppose that a man has by some peculiar circumstances been imposed upon, and has through the imposition, purchased a book or a print, paying for it twice or three times as much as it was worth. Now although the book might of itself have been a source of pleasure to him had he obtained it in an ordinary way, the recollection of the transaction and the fraud of which he was the victim, will be so strongly associated with the sight of the object, that it will probably for a long time, and perhaps always, suggest nothing but painful ideas.

It is not surprising then, since these accidental associations add a fictitious value to some objects and diminish the real value of others, that they should be the origin of a vast portion of the difference of opinion which prevails among mankind. There is, we will imagine, a beautiful valley, near a retired and happy village ; a road winds through it on the banks of a beautiful rivulet by which it is watered. Now let us suppose that in this se-

questered spot, one man has been accustomed to walk at evening to spend an hour in meditation, and the scene has become associated in his mind with all the interesting thoughts which such an hour of meditation will bring, — and another has made it the scene of an intended robbery. Perhaps he lays wait here for his victim and either succeeds or fails, it is not of much consequence for our purpose which, in perpetrating his crime. Now let years pass away, — let the two individuals in question, after having left the village and spent a long period in distant places, at length return and come within sight of this pleasant valley once more. Now how different will be the feelings which the sight of it will awaken. The one will hasten to its sequestered retreats again with delight. He will ramble through every part of it, recognising every rock and tree and every winding of the stream, and having the most pleasing recollections awakened by the sight of every one. The other will feel a corroding remorse, disturbing his quiet as soon as his eye catches the most distant glimpse of the scene of his crime, and he will go far out of his way to avoid a nearer and more painful view.

Such a difference of feeling is by no means confined to such cases as this, where some powerful causes operate to produce a very striking difference and feeling. Almost every person will observe, if he examines the feelings with which he regards the various places and scenes within his knowledge, that there is a very distinct dislike to some and a peculiar interest in others, which at the first view he cannot easily account for. On examination however it will be found that some causes, similar in principle to those above described, occasion this difference. Some associations, arising from circumstances which a little effort at recollection will call to mind, will generally be found to be connected with the different objects, in such a manner as to produce the results which at first view could not easily be explained.

Almost all persons have preferences and dislikes in regard to names, and these will almost invariably be found to depend upon associations. Let any young person make

out a list of such names as he likes and also of such as he dislikes, and it will generally be found that his feelings in regard to them can be explained by his finding that the names which he likes have belonged to individuals whom he likes, either real or fictitious, and that he has a distaste for those names which have belonged to persons who have been disagreeable to him. It must be remembered, however, that it will be necessary to go back to the early periods of youth, or even of childhood for the foundation of these preferences, as those early associations are far more powerful than any other.

3. *The influence of associations in producing prejudices.* The prejudices with which human minds are everywhere filled, and by which individual happiness, and often the peace of communities is destroyed, seem to have their origin in two distinct sources. First the partial acquaintance which men often have of the subjects upon which they form their opinions, which is sometimes the result of ignorance, and sometimes of a bias of mind produced by their inclinations or their interests ; and secondly having some accidental associations connected with a subject, which give them a favorable or an unfavorable view not founded upon intrinsic merit. This latter source is, to say the least, as prolific as the former.

A very common instance of it is the first impressions, favorable or unfavorable, which we form of a new acquaintance. Perhaps all persons, except the few that have learned wisdom in this respect by experience, form almost immediately upon sight of a stranger, some opinion of him, and this opinion is often very decided. It is usually based upon some accidental circumstance having little or no connexion with his character, and yet many weeks and often months or years of acquaintance, will not obliterate it. With children the slight circumstance, on account of which the stranger is thus condemned or approved, without any just cause, is usually some trifling peculiarity of dress or manner. With men it is something more important perhaps, but equally unmeaning as an indication of character. He belongs to a different party, or to a different denomination, — or

his language, or habitation, or the company or circumstances in which we first see him, are such as to impress us favorably or unfavorably at the outset, and yet slight as such circumstances are as grounds of judgment for or against a man, all are influenced by them to a very great degree.

The various dislikes and preferences in regard to dress, which almost all indulge, are among the most striking examples of prejudices produced by association. A style of dress which is seen adopted by the upper classes of society is pleasing, because it is associated with ideas of rank, or wealth, or elevated station. Let it become common and the charm is broken. If it is seen in connexion with the vulgar or the low, an unpleasant association degrades it as certainly as the agreeable one had elevated it. The very article or style which had been so alluring when it reminded us of the wealthy and the genteel, is repulsive when it becomes connected with repulsive associations.

The above remarks will explain almost all the differences of opinion in what are called matters of taste. Two ladies will disagree in opinion about the color of a ribbon, or the form of a bonnet, and if they know any thing of this law of mind, and the overwhelming influence it has in the formation of our opinions, they will both be aware that the color or the form, which excites emotions of pleasure in the one, and those of a contrary character in the other, produces these different effects solely by the fact, that the two individuals have different associations connected with it. The one has been seen in agreeable and the other in disagreeable connexions, and their opinions are formed accordingly. Sometimes a vain effort is made to settle the question by argument, but it always fails. A dislike in such a case is not founded upon argument, and argument consequently cannot destroy it. The only way by which it can be overcome is by *new associations*, which may overpower the old.

This method will be infallible. Every lady will recollect many examples of a fashion which, when she first observed it, was strongly disliked, but in regular time, that is, after having seen it for the usual period associa-

ted with rank or wealth or gentility, it became agreeable and she herself adopted it.

This casual connexion of unpleasant thoughts with objects which are themselves agreeable, and the consequent effects, is not confined to things so trifling in themselves as the form and fashion of dress. The writer of this tract was, when quite young, riding on a delightful evening in May with a widow lady who seemed as evening came on to become dejected and depressed, just in proportion as the landscape assumed its peculiar expression of loveliness and peace. After a little time the lady remarked, that to many persons the advance of spring, and the coming forth of leaves and flowers, and the singing of birds was cheering and delightful, but to her, these circumstances were most melancholy, and the season which brought them rolls the saddest season of the year.

'Was it always thus with you ?' asked the writer.

'No,' she replied. 'Not until the death of my husband and children. Ten or twelve years ago they died all within a few weeks of each other, in the spring of the year ; I was living in a most delightful country, and for several weeks I watched in their sick chambers, with the cheering sounds and appearances of spring all around me, and they became so strongly associated with the sufferings of those whom I loved, and with my own irreparable losses, that I never could efface the impression. Ever since that time, the spring, as often as it returns, almost breaks my heart.

The exhibition of these principles of association, and the reflection of our readers upon the subject, will be of very great practical advantage if a practical application is made to the individual's own habits of thought and of action. We shall in many cases, place less confidence in our own opinions, if we realize upon what slight foundations many of them must stand, and we shall be less displeased to find others differing from us, if we are aware that, in a vast many cases, a difference of opinion is the result of a difference of mere circumstances altogether adventitious, by which associations favorable or unfavorable are connected with the subject on which

we disagree. A wise man will especially guard against all pertinacious adherence to his own notions, or sweeping condemnations of those of other persons, in matters of mere taste and fancy; for in these cases it is association alone which is almost the whole foundation of our preferences and dislikes.

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SCIENTIFIC TRACTS.

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THE BEE.

The Bee tribe of insects is very large, embracing a vast variety of species. The general characteristics of the genus are four membranaceous wings, and the female being armed with a sting. This genus is called by naturalists *apes*, and there are no other genera of insects which comprehend a greater number or variety. In this article our attention will be directed to but one species, the common honey or domesticated bee.

Almost from time immemorial this useful little insect has attracted the attention and the admiration of man. Treatises respecting its habits, and the mode of its cultivation, are frequently found from the pens of the ancient classic writers. And their poetry is interspersed with images and illustrations drawn from their domestic economy. The bee is found in almost every country, and sips honey alike from the flower which blooms in the city and the wilderness.

In the warmer latitudes where a meridian sun adorns the landscape with almost perpetual bloom, this little insect finds its most congenial home. It revels amid the luxuriant vegetation of the tropics with but little care from the hand of culture, and the abundant produce of its industry affords one of the richest luxuries.

The skill, the industry, and the wonderful order preserved by these little animals, have excited much astonishment, and their history is replete with interest and instruction. The sagacity which they manifest is perhaps surpassed by that of no other animal. Their little empire is gov-

erned by laws more unvaried than those of the Medes and Persians, and even the most iudustrious of our species may learn a lesson from the persevering diligence of this little insect. The skill in workmanship, which the arrangement and construction of their cells exhibit, is truly wonderful. And the amount of honey which they collect in one season, shows with what unwearied diligence they pursue their toils. 'When the day is fine and the sun shining brightly, the habitation of these marvellous little creatures exhibits the aspect of a populous and busy city. The gates are crowded with hundreds of industrious workers — some on the wing in search of sustenance; others returning from the field laden with food — some earnestly engaged in building — some in tending the young — others employed in cleansing their habitation — while four or five may be seen dragging out the corpse of a companion, and, as it would appear, scrupulously paying the last honors to the dead. At one moment the entrances of the little city are comparatively free; at another, crowds of its inhabitants may be seen struggling at the gates, making the best of their way to escape from the rain, which by some peculiar sensation they have discovered to be at hand. It can therefore excite no wonder that the habits of these interesting insects should have attracted the attention of some of the best observers of ancient and of modern times.' Probably honey was long used before bees were domesticated. Innumerable swarms were continually depositing their precious stores in the groves of Palestine, so that the land was said to flow with milk and honey. History does not inform us when these industrious little insects were brought from their native grove to labor for man. But now in all parts of the civilized world the cheerful hum of the bee is heard in the farm yard. Long and careful examination of their habits has swept away fabulous stories engendered by imagination, and has brought to light the real history of the bee, replete with interest and wonder.

THE STRUCTURE OF THE BEE.

In every hive or swarm of bees there are three classes. 1. A female, or queen bee. 2. Males, or drones, which

do no work. 3. The common working bees, which are supposed to be of no sex. These three classes are so different from each other that they are very easily distinguished. There is but one queen bee in each swarm and she is the prolific mother of many thousands. She is larger in every respect than the common working bee, and longer, though not so large in the trunk as the male. The queen bee is distinguished from the working bee simply by the size. There is a little difference in color but this is so small that it is not easily distinguished. The belly of the queen bee is of a lighter color than that of the working bee, but that is a part of the body which is not often exposed. When a hive is killed, by spreading the bees upon white paper, the queen by her size and color may be easily found. The queen has a sting similar to the working bee. The male bee is larger than the laborers, and is considerably thicker than the queen. His proboscis appears not to be formed for collecting honey for it is much shorter than that of the working bee. He is never found abroad on flowers, and is not provided with a sting. There are but few males in the hive, some state the number to be four or five hundred; others suppose it to be much less.

The class of laboring bees, is the largest in number, there being in a common hive seven or eight thousand. Their organization demands a more minute description.

'In examining the structure of the common working bee, the first remarkable part that offers is the trunk, which serves to extract the honey from flowers. It is not formed like that of other flies, in the manner of a tube, by which the fluid is to be sucked up, but like a brush broom to sweep, or a tongue to lick it away. The animal is furnished also with teeth which serve it in making wax. This substance is gathered from flowers. Like honey it consists of that dust, or farina, which contributes to the fecundation of plants, and is moulded into wax by the little animal at leisure. Every bee when it leaves the hive to collect this precious store, enters into the cup of the flower, particularly such as seem charged with the greatest quantities of this yellow farina. As the animal's body is covered over with hair, it rolls itself within the flower, and

soon becomes quite covered with the dust, which it soon after brushes off, with its two hind legs, and kneads into two little balls. In the thighs of the hind legs there are two cavities edged with hair, and into these as into a basket the animal sticks its pellets. Thus employed the bee flies from flower to flower, increasing its store and adding to its stock of wax, until the ball upon each thigh becomes as big as a grain of pepper. By this time, having got a sufficient load, it returns, making the best of its way to the hive.

The belly of the bee is divided into six rings which sometimes shorten the body by slipping one over the other. It contains within it, beside the intestines, the honey bag, the venom bag, and the sting. The honey bag is as transparent as crystal, containing the honey that the bee has drawn from the flowers, of which the greater part is carried to the hive, and poured into the cells of the honey comb, while the remainder serves for the bee's own nourishment; for during summer it never touches what has been laid up for the winter. The sting which serves to defend this little animal from its enemies, is composed of three parts; the sheath and two darts which are extremely small and penetrating. Both of the darts have several small parts or barbs like those of a fishhook, which render the sting more painful and make the darts rankle in the wound; still however this instrument would be very slight did not the bee poison the wound. The sheath which has a sharp point, makes the first impression which is followed by that of the darts, and then the venomous liquor is poured in. The sheath sometimes sticks so fast in the wound that the animal is obliged to leave it behind, by which the bee soon after dies, and the wound is considerably inflamed. It might at first appear well for mankind if the bee were without its sting; but upon recollection it will be found that the little animal would then have too many rivals in sharing its labor. A hundred other lazy animals, fond of honey and hating labor, would intrude upon the sweets of the hive, and the treat sure would be carried off for want of armed guardians to protect it. The concentric rings which compose the belly of the bee are of a hard horny substance and im-

pervious to the sting. Thus encased in coat of mail, they often engage for a long time in bloodless battles. The intervals however between the rings of the belly are vulnerable. In this point their attention is directed to their battles. And the bee which succeeds in thrusting its sting between these rings, lays his antagonist in an instant lifeless at his feet.

GENERATION.

'How numerous soever the multitude of bees may appear in one swarm, yet they all owe their origin to a single parent, which is called the queen bee. It is indeed surprising that a single insect should in one summer give birth to above twenty thousand young. But upon opening her body the wonder will cease, as the number of eggs appearing at one time amounts to five thousand. This animal whose existence is of such importance to her subjects, may easily be distinguished from the rest, by her size, and the shape of her body. On her safety depends the whole welfare of the commonwealth, and the attentions paid her by all the rest of the swarm evidently show the dependence her subjects have upon her security. If this insect be carefully observed she will be seen at times attended with a numerous retinue, marching from cell to cell, plunging the extremity of her body into many of them and leaving a small egg in each.

When the queen bee has deposited the number of eggs necessary, in the cells, the working bees undertake the care of the rising posterity. They are seen to leave off their usual employments, to construct proper receptacles for eggs, or to complete those already formed. They purposely build little cells extremely solid, for the young, in which they employ a great deal of wax. Those designed for lodging the males, as was already observed, are larger than the rest, and those for queen bees, largest of all. There is usually but one egg deposited in every cell. When the fecundity of the queen is such that it exceeds the number of cells, already prepared, there are sometimes three or four eggs crowded together in the same apartment. But this is an inconvenience which

the working bees will by no means suffer. They seem sensible that two young ones, stuffed up in the same cell, when they grew larger would but embarrass and at last destroy each other. They therefore take care to leave a cell to every egg, and remove or destroy the rest.

The single egg that is left remaining, is fixed to the bottom of the cell, and touches it but in a single point. A day or two after it is deposited, the worm is excluded from the shell of the egg, having the appearance of a maggot rolled up in a ring, and lying softly on a bed of whitish colored jelly, upon which also the little animal begins to feed. In the meantime, the instant it appears, the working bees attend it with the most anxious and paternal tenderness. They furnish it every hour with a supply of this white substance, on which it feeds and lies, and watch the cell with unremitted care. They are nurses that have greater affection for the offspring of others, than many parents have for their own children. They are constant in visiting each cell, and seeing that nothing is wanting; preparing the white mixture, which is nothing but a composition of honey and wax, in their own bowels, with which they feed them, thus attended and plentifully fed, the worm in less than six days' time comes to its full growth, and no longer accepts the food offered it. When the bees perceive that it has no further occasion for feeding, they perform the last offices of tenderness, shut the little animal up in the cell, walling up the mouth of its apartment with wax; there they leave the worm to itself having secured it from every external injury.

The worm is no sooner left enclosed but from a state of inaction it begins to labor, extending and shortening its body and by this means lining the walls of its apartment with a silken tapestry which it spins in the manner of caterpillars before they undergo their last transformation.

When their cell is thus prepared, the animal is soon after transformed into an aurelia: but differing from that of the common caterpillar, as it exhibits not only the legs, but the wings of the future bee, in its present state of inactivity. Thus, in about twenty or one and twenty days after the egg was laid, the bee is completely formed, and

fitted to undergo the fatigues of its state. When all its parts have acquired their proper strength and consistence, the young animal opens its prison, by piercing with its teeth the waxen door that confines it. When just freed from its cell, it is as yet moist, and incommoded with the spoils of its former situation: but the officious bees are soon seen to flock round it, and to lick it clean on all sides with their trunks; while another band with equal assiduity, are observed to feed it with honey; others again begin immediately to cleanse the cell that has just been left, to carry the ordures out of the hive, and to fit the place for a new inhabitant. The young bee soon repays their care by its industry; for as soon as ever its external parts become dry it discovers its natural appetites for labor, and industriously begins the task, which it pursues unremittingly through life. The toil of man is irksome to him, and he earns his substance, with pain; but this little animal seems happy in its pursuits, and finds delight in all its employments.

When just freed from the cell, and properly equipped by its fellow bees for duty, it at once issues from the hive, and instructed only by nature, goes in quest of flowers, chooses only those that yield it a supply, rejects such as are barren of honey, or have been already drained by other adventurers; and when loaded, is never at a loss to find its way back to the common habitation. After this first sally, it begins to gather the mealy powder that lies on every flower, which is afterwards converted into wax; and with this the very first day it returns with two large balls stuck to its thighs.'

The fertility of the queen mother is prodigious. It is said that during one season a single female will lay from 70,000, to 100,000 eggs. Two or three distinct colonies are often formed in one summer. It appears from repeated experiments, that the love of offspring is the great motive which spurs them on to labor. Take away from a hive the queen bee, and you put all effectual stop to industry. Not a single cell is constructed; not a particle of honey is stored up. Reaumur* tried this experiment

* A celebrated French philosopher born at Rochelle, in 1683. He wrote largely upon insects, and his works upon philosophy and

in various ways. He divided a swarm, leaving the queen bee, with one part, and leaving the other part without a female. Both parts were placed in commodious hives, but those without a queen appeared to surrender themselves to indolence and despair. The brightest day could lure but few of them to the fields. Those who went, returned with no stores to the hive; their only object appeared to be, to satisfy the immediate cravings of hunger. Inaction and famine spread fatal diseases through their desolate dwelling, and every morning found the bottom of the hive covered with the lifeless remains of those who had fallen during the night. Daily their numbers diminished, and at the close of three weeks scarcely one thousand were left alive, and the whole of these were one morning found dead in the bottom of the hive. There is something truly tragical in their mournful history.

That part of the swarm however with whom the queen bee was left, immediately commenced persevering and vigorous efforts in the construction of cells for the young and for depositing honey. The laborers were continually returning with their little thighs laden with the rich treasure, and the whole hive assumed the aspect of cheerfulness and of thriving industry. The prospect of offspring appeared to animate all. From repeated experiments of this nature Reaumur concludes, that 'we are only sure of one principle of action among bees — the love for their queen, or rather the numerous posterity to which she is to give birth. Each bee is actuated either by a sensation which has in view the welfare of all, or by the love of posterity. Whether they construct cells or most carefully polish them, or labor to gather a harvest of honey, it is never directly for themselves. This may appear somewhat paradoxical to those who have remarked that at the end of the winter, the bees consume the honey they had stored up in the spring and summer. But the experiments just detailed show, that the moment they lose the hope of a numerous progeny, they cease to gather the food which is necessary for their own preservation;

physics, have given him a high rank among the literati of the world. He died 1757.

life seems to them of no value, when unsupported by this hope, and so they choose to die. The love of offspring appears to be therefore the all moving principle.' The same experiment has been tried by others and always with similar results.

After the egg of the common working bee is deposited, three days elapses before it assumes the vermicular state. After remaining in this state five days the cell is closed up with a covering of wax. When thus covered and protected, the embryo insect is not idle, but labors diligently at the distaff, spinning the cocoon. This is a labor of thirtysix hours. In three days it changes to a nymph and passes six days in this form. And it is not until the twentieth day from the time the egg was laid, that it attains the fly state. The progress of the royal worm through the various stages of its infancy is rather more rapid. In sixteen days from the time that the egg was deposited on its princely couch, the perfect state of queen is attained. The male worm or drone is metamorphosed into a fly on the twentyfourth day after the egg is laid. 'One of the most astonishing facts connected with the economy of bees, is the manner in which, when deprived of their queen, they proceed to repair their loss; for this purpose they construct several of these royal cells, and taking a common worker worm out of the common cells, they put it into a royal one, feed the insect with royal food, which is more pungent than that destined for worker grubs, and in a few days instead of a worker they have a queen. This extraordinary discovery made by Shiruch, has been confirmed by Huber, and is now admitted by all naturalists. In many parts of Germany, and more especially in Sasatia and Saxony, the peasants availing themselves of this discovery, are enabled to multiply their swarms of bees at pleasure; they shut up a few hundred working bees, with a piece of honey comb, containing common grubs, three or four days old; the worker bees immediately set about destroying some of the common cells; construct royal cells in their state; deposit the grubs in those cells and administer to them food proper for grubs destined to become queens. This experiment is constantly repeated and

never found to fail. In the proper time a number of young queens is produced. The supernumeraries are destroyed; and at length only one survives to govern the hive. Thus wonderfully does nature provide for the preservation of the species — the life of thousands of these insects depending on that of a queen. In order to guard against the possibility of extermination, she has taught the bee the miracle of converting the whole of the instincts and organization of one kind into those of another, by the simple means of providing a different and a more pungent kind of food for the subject of its marvellous experiment. There seems, however, to be a natural provision for this change; for it is found that all the workers are imperfect females, whose organs are not developed; the food simply furthers this development. But whether we look to the design or the means used, or the circumstances under which it is affected, it is one of the most striking facts in the whole range of natural history.

CONSTRUCTION OF CELLS.

The skill in architecture which these little insects display, even surpasses what would be anticipated from previous manifestation of sagacity. One would suppose that their native instinct would guide them to a uniform mode of constructing their cells. But they are not thus restricted. Governed by circumstances, they appear to take into consideration the form and size of the hive and to arrange and construct their cells in a manner most suitable to the existing case. Indeed no man in the plan of his own commodious house, can give more decisive evidence of study and design than is exhibited in the interior arrangements of the dwellings of the bees. Their little city is laid out into numerous convenient streets and lanes, and their blocks of buildings are never permitted to project into the high-way, or to run in zigzag lines, obstructing the throngs of laborers who are continually passing and repassing in the performance of their appropriate duties. What is called the honey comb, is composed of two layers of six sided cells, united by

their bases. The combs are longer or shorter as best suits their convenience. 'Reaumur suspected from the hexagonal form of the cells, and the uniform inclination of the base, that this was the most economical form which could be adopted with respect to the quantity of wax necessary. Without intimating his object, he presented for solution the following problem to Koenig, a celebrated analyst, "among all the hexagonal tubes with pyramiddal bases, composed of three similar and equal rhombs, to determine that which can be constructed with the least possible quantity of matter." Koenig worked out the problem, and replied that if three rhombs were so inclined to each other that the great angles measured 109° 26′ and the little angles 70° 34′, this construction would require the least quantity of matter. Reaumur found by accurate measurement, that the great angles gave 109° 28′ and the little one 70° 32′! How surprisingly is the wisdom of God manifested in endowing these insects with a wisdom surpassing that of many of even the wisest of the human family.

It is stated by Huber, that the principle of a division of labor is adopted very extensively in all the operations of the hive. In constructing cells, different parts of the labor are performed by different bees. Some appear to be highly accomplished architects, who plan and build the edifice. They are also the nurses and protectors of the young. Others seem to labor in more humble employments, and merely bring the raw material.

The wax is not a simple substance which the bees collect ready formed, but it is a secretion from their own bodies. The wax workers having fed plentifully upon the delicious nectar which they find in the cups of almost every flower, remain in a state of repose for about twentyfour hours, during which time the wax is formed and secreted in layers or scales beneath the belly. These scales they take hold of with the little pincers with which their legs are furnished, and peel off. The bee then kneads the detached scale with its tongue and deposits it in the proper place for the formation of the cells. Another and another does the same. A little block of wax being thus collected, an architect takes the work under his own

care, and with his tongue for a trowel, he moulds his materials into the proper form, and with unwearied diligence smooths and polishes his beautiful edifice. Though the labor, for these little insects, is immense, yet the work progresses with great expedition, for all are diligent in contributing their mite. One wax worker after another deposites his tiny burden, and there are many busy laborers on the alert fashioning the raw material into the proper form. The hive of the bee affords a most beautiful illustration of what may be accomplished by persevering industry.

Goldsmith, who has given fascination to every subject his pen has touched, thus vividly describes this interesting department of the bee's labor.

'If we examine their cells they will be found formed in the exactest proportion. It was said by Pappus, an ancient geometrician, that of all other figures hexagons were the most convenient, for when placed touching each other the most convenient room would be given and the smallest lost. The cells of the bees are perfect hexagons. These, in every honey-comb, are double, opening on either side, closed at the bottom. The bottoms are composed of little triangular panes, which when united together terminate in a point and lie exactly upon the extremities of other panes of the same shape in opposite cells. These lodgings have spaces like streets between them large enough to give the bees a free passage in and out, and yet narrow enough to preserve the necessary heat. The mouth of every cell is defended by a border, which makes the door a little less than the inside of the cell. It serves to strengthen the whole. These cells serve for different purposes: for laying up their young; for their wax, which in winter becomes a part of their food; and for their honey, which makes their principal subsistence.

Their teeth are the instruments by which they model and fashion their various buildings and give them such symmetry and perfection. They begin at the top of the hive and several of them work at a time at the cells, which have two faces. If they are stinted with regard to

time they give the new cells but half the depth, which they ought to have, leaving them imperfect till they have sketched out the number of cells necessary for the present occasion. The construction of their combs costs them a great deal of labor. They are made by insensible additions, and not cast at once in a mould as some are apt to imagine. There seems no end to their shaping, finishing and turning them neatly up. The cells for their young are most carefully formed. Those designed for lodging the drones are lower than the rest, and that for the queen bee the largest of all. The cells in which the young brood are lodged, serve at different times for containing honey; and this proceeds from an obvious cause: every worm before it is transformed into an aurelia, hangs its old skin on the partition of its cell, and thus while it strengthens the wall diminishes the capacity of its late apartment. The same cell in a single summer is often tenanted by three or four worms in succession, and the next season by three or four more. Each worm takes particular care to fortify the pannels of its cell by hanging up its spoils there. Thus the partitions being lined six or eight deep, become at last too narrow for a new brood, and are converted into store-houses for honey. Those cells, where nothing but honey is deposited, are much deeper than the rest. When the harvest of honey is so plentiful that they have not sufficient room for it, they either lengthen their combs or build more, which are much larger than the former. Sometimes they work at three combs at a time, for when there are three work-houses, more bees may be thus employed without embarrassing each other.

SWARMING OF BEES.

The departure of a colony from the parent hive to seek their fortunes and a home for themselves, is a most singular and interesting phenomena. Different opinions have been expressed upon this subject by naturalists, who have paid much attention in investigating the habits of the bee. Early in the spring the front of the hive is often seen for several days, perfectly covered with bees,

as though the interior was too narrow for the thronging population. They appear moving about as in a state of indecision, till finally on some pleasant morning, a queen Bee followed by seven or eight thousand subjects, emerges from the hive, and after fluttering about for a few moments, as though bidding their home a lingering adieu, or waiting for any stragglers who may be disposed to join their party, they take a high and rapid flight in a direct line in search of a new abode. It has generally been supposed that the young swarm, headed by the youthful queen, compose this colony. ' But it is now pretty well established that it is a promiscuous assemblage of old and young bees, headed by the old queen, and that she leaves the sceptre of the hive to her youthful daughter, who at the moment of her birth becomes her enemy and rival.

There is a most deadly animosity subsisting between the female bees. Sometimes there are as many as twenty royal cells in a hive, in each of which the queen deposits an egg, which does not differ in appearance from those placed in the other cells. In size it is a little larger. The instinctive animosity of the queen mother does not however manifest itself against her female progeny, till the worm is transformed into a nymph. Still the working bees appear to be conscious of the danger to which their young females are exposed from maternal malice, and a strong body guard is continually stationed at each royal cell. The sight of these cells appears to give the queen mother the excitement of delirium. She rushes with infuriated haste to the yet unopened cradles of her children, her submissive subjects retiring before her, and unchecked she barbarously murders her offspring. But her impetuosity is too great to be long continued. Having torn away from two or three of the cells the thick coating of wax, which protects the infant queens, she becomes exhausted, and is unable to proceed any farther, in her inhuman employment. The excitement, however, which she has manifested, is communicated to others and soon spreads through the hive. All seem to be in uproar and confusion, and the old queen driven away by jealousy or fear, and followed by a large portion of her sub-

jects, rushes from the hive, and leaves her empire to the undisputed possession of her hated daughters. It is said that in every instance it is the old queen which leads the first swarm.

The multiplication of bees is so immense that it is absolutely a matter of necessity that large parties should continually emigrate. It is said that the young ones remain at home as long as the hive is sufficiently large, to accommodate them. The provision of nature to accomplish this end is singular. To see passion and cruelty raging through all the brute creation, is one of those mysteries which remain as yet unfolded. We should have anticipated an affectionate, or at least a peaceful and a good natured departure. But it is the hatred of the mother for her daughters which drives the queen from her hive, and she goes imbrued with the blood of her children. We can see the wisdom of the *object to be attained* but the *means*, by which God has seen fit to have this object accomplished, are to us dark and mysterious. The cruelty which is raging through the animal creation, is one of the unfathomable mysteries of earth.

For several days before the young ones swarm, it is not unusual to see them hanging in thick and black clusters about the hive, as if there were not sufficient room for them within. This is undoubtedly the case, yet in wet weather they contrive to stow themselves away, though the lanes and alleys of their little city must be greatly crowded, by this immense population.

About six or seven thousand compose the average number of a swarm. In this number there is but one female, the queen bee, several males or drones, who do not work, and the common laboring bees. Before leaving the hive they supply themselves liberally with food as though preparing for a long journey. They usually set off from the hive about the middle of the day, and often immediately after a shower. In what manner they communicate their ideas so as to move simultaneously, it is difficult to imagine, but they are clearly actuated by some common principle. They hover a few moments about the hive as though waiting for any tardy straggler, and then with rapid wing turn from home, the wide world before them.

They take their flight high in the air, and sometimes proceed to a great distance. Often every effort of the owner of the hive to stop the swarm is unavailing, and they depart never to be seen again. More frequently however they light upon the limb of a tree or some other such object at no great distance from the hive. It is said that any noise which will drown the hum of their leader, will so confuse them that they are compelled immediately to alight. Hence you often perceive a swarm of bees pursued with all the noises which shovels and tongs, tin pans, &c, can produce. If they are not induced to alight, and collect into a new hive, they seek out some hollow tree, and there commence the formation of comb. If the orifice is too large, they build a thick coating of comb until it is made of suitable dimensions. As soon as they have selected their habitation they immediately begin to make their combs, for they carry the materials for this purpose from their parent hive. Having repaired their new habitation without delay, they commence their industrious labors. Every department of business thrives under their harmonious and well organized efforts. In warm weather one strong hive has been known to send off four swarms in eighteen days.

DOMESTIC HABITS.

Bees generally perform their labors in a peaceful manner without interfering with each other's rights. But sometimes they prefer to obtain their honey by stealth rather than by honest labor. Occasionally the inhabitants of two hives, will wage against each other most implacable war. The whole summer is passed in cruel and deadly contest, and the ground in front of the hives may be seen covered with the bodies of the slain. I have watched these furious battles with amazement. Two bees would meet with all the spite and fury imaginable in such little creatures. With mouth and sting they would make most vigorous efforts. Apparently unmindful of everything else, they would mount high into the air, in the contest, or roll over in the dust in deadly embrace. Their stings might be seen glancing from the coat of

mail, with which their bodies are encased, till one succeeds in suffocating the other by pressing its chest, or adroitly thrusts its sting between the scales of its body and thus instantly deprives it of life. In this insect commonwealth, generally so well governed, murder passes unpunished, and their private disputes are immediately settled by an appeal to arms. 'On those fine spring days in which the sun is beautiful and warm, duels may often be seen to take place between two inhabitants of the same hive, the offspring of the same mother. The causes which bring division into so united a society have not been hitherto ascertained. In some cases the quarrel appears to have begun within, and the combatants may be seen coming out of the gates eager 'for blows.' Sometimes a bee peacably settled on the outside of the hive, or walking about, is rudely jostled by another, and then the attack commences, each endeavoring to obtain the most advantageous position: They turn, pirouette, throttle each other; and such is their bitter earnestness that Reaumur has been enabled to come near enough to observe them with a lens, without causing a separation. After rolling about in the dust, the victor, watching the time when its enemy uncovers his body, by elongating it in the attempt to sting, thrusts its weapon between the scales, and the next instant its antagonist stretches out its quivering limbs and expires. A bee cannot be killed so suddenly, except by crushing, as by the sting of another bee. Sometimes the stronger insect produces the death of the vanquished by squeezing its chest. After this feat has been done, the victorious bee constantly remains, says Reaumur near his victim, standing on his four front legs and rubbing the two posterior ones together. Sometimes the enemy is killed in the hive; then the victor always carries the corpse out of the city and leaves it. These combats are strictly duels, not more than two being concerned in them; and this is even the case when armies of bees meet in combat.'

Highly as we may applaud the industry of the bee, its honesty after all, is rather questionable. In moral in-

tegrity it must be confessed they are at times very lax. Like piratic coasters, these relentless insects, will sometimes overtake a rich merchantman of a humblebee, and they will not let him depart till they have relieved him of his rich stores. It is indeed amusing, — though you cannot help compassionating the poor humblebee, — to see four or five of these nimble highway robbers, mauling and pommelling their awkward and clumsy victim, till they have compelled him to relinquish every particle of the honey, he has been so laboriously gathering. They then liberate him to return to his labors under the discouraging anticipation of being again in like manner pilfered of whatever he may collect.

Though the honey bee appears to have no antipathy to fraud, he is the inveterate enemy of idleness. The lazy drones are permitted to live during the summer months, when every flower is laden with its sweet treasures, but as soon as autumn comes, and the bees must be sustained during the winter upon what they have been able to collect in the summer, the then useless drones are murdered. They seem to adopt most rigidly the sentiment, 'If any one will not work neither let him eat.' The drones are born in April or May. For a few weeks, they live in genteel luxuriance, but in August they are indiscriminately massacred. Huber who has with great diligence and perseverance studied the habits of this insect observed one day the commencement and the termination of this cruel slaughter. As the drones are unarmed they have no safety but in flight. The rage of the whole hive seemed to be simultaneously roused. The drones fled in terror; but overpowered by numbers escape became impossible, and they were all soon stretched lifeless upon the bottom of the hive. And what is very remarkable, in six different hives, this work of extermination was going on at the same hour. It is not unusual for some of the workers also to be included in the list of proscription; obnoxious in consequence of old age or some other cause unknown to us, their associates put them out of existence.

'Among other virtues possessed by bees, cleanliness is one of the most marked: they will not suffer the least

filth in their abode. It sometimes happens that an ill advised slug, or an ignorant snail, chooses to enter the hive, and has even the audacity to walk over the comb; the presumptuous and foul intruder is quickly killed. But his gigantic carcase is not so speedily moved. Unable to transport the corpse out of their dwelling, and fearing the noxious smells arising from corruption, the bees adopt an efficacious mode of protecting themselves; they embalm their offensive enemy by covering him over with propolis; both Muraldi and Reaumur have seen this. The latter observed that a snail had just entered a hive and fixed itself to the glass side, just as it does against walls, until the rain shall invite it to thrust out its head beyond its shell. The bees it seems did not like the interloper, and not being able to penetrate the shell with their sting, took a hint from the snail itself, and instead of covering it all over with propolis, the cunning economists fixed it immovably by cementing merely the edge of the orifice of the shell to the glass with their resin, and thus it became a prisoner for life, for rain cannot dissolve this cement, as it does that which the insect itself uses.'

BEE HUNTING.

In many parts of the world bees are found in great numbers in the woods. In the unbroken forests of our own country honey is found in great abundance, and there are men called bee hunters, who make a living by obtaining the treasures of their hives. In the forest of Maine, it is not an uncommon amusement for young lads to go through the woods in quest of bees. A boy will take a small box of honey in his hand and a little flour in a paper, and walk along till he finds upon some wild flower a honey bee. He opens his box, and the bee allured by the fragrance of the honey, immediately seeks a supply from its abundance. While the bee is feeding the boy carefully sprinkles upon it a little flour. As soon as the bee has obtained its load, it sets out in a direct line for the hive. The boy watches the direction of its flight and quietly sits down and waits its return. By and by the bee returns, bringing others with him. The boy

identifies the insect, by the flour which he has sprinkled upon its back, and judges of the distance of the hive, by the time it has taken the bee to go to it, and return. An experienced bee hunter, will in this manner judge with great accuracy. The boy having thus ascertained the direction of the hive, and having formed some estimate of its distance, proceeds till he supposes he has gone far enough, and then if he does not find the hive he again seeks a bee and repeats the experiment. Perhaps the next bee he finds flies in a very different direction from the first. This informs him that the second bee belongs to some other hive. And thus he has the trace of two hives. By one or two such experiments he is almost invariably conducted to the treasure for which he is in search. Having found the hive, he marks the place and returns home. 'Sometimes the honey hunters, set a plate of honey or sugar upon the ground, and in a short time this is discovered by the wild bees. Having caught two or three of those that have taken their fill, the hunter first releases one, which rising into the air, flies straight to the nest. He now walks at right angles to the course of the bee, for a few hundred yards, and then lets another go, which also after rising, flies to the nest. Observing with his pocket compass, the angle where the two lines formed by the two courses of the bees meet, there he knows will be the spot, at which the nest is placed.'

A few years ago I was in the north-western part of the state of Maine, and hearing of a party who were going out to take a nest, which had previously been found, I accompanied them. Four or five men with axes and pails, and materials for striking fire, set out in a damp and cloudy afternoon. After groping our way over stumps and logs and through thick woods for about a mile, we came to an old and partially decayed tree of unusual size. One of the men pointing towards the top of the tree, said, "there's the nest." About thirty feet from the ground I could just perceive a few bees hovering about the hole through which they found their way into the hollow of the decayed tree. Having decided in what

direction it would be best to fell the tree, two men commenced with their axes at its root. As one stroke succeeded another the bees seemed a little alarmed, but they did not come down to offer any resistance. While two were cutting down the tree, others were collecting large strips of birch-bark for torches. Just as the tree was ready to fall two or three stood ready with their birch-bark flambeaux, and at the moment the tree fell, they ran to the hole from which the bees were rushing, and burnt them down as fast as possible. The bees however were in spite of their torches, flying thickly about, and making a most desperate resistance. All the men were stung more or less, but they did not seem to mind the bees more than a swarm of flies. Very soon the ground was covered with the poor little insects crawling about with their wings singed off. The bees seemed now perfectly satisfied that resistance was in vain, and with a prudence which was perfectly amazing, they gave up the contest. The men very soon split open the tree and exposed the honey to view. The comb was still covered with thousands of the insects, who were endeavoring to save all that they could from the dreadful ruin of their happy home. Much as I loved honey I could not restrain a feeling of sincere compassion. And I would gladly have seen the tree again erected, and the bees in the untroubled enjoyment of their well earned stores. A man would take up a large piece of comb, and with his bare hand, brush off the thousand of bees collected upon it. Soon the honey was all deposited in the pails, and our party returned triumphantly home with their booty. The poor bees were left, some to seek another home, and others to linger and die in protracted agonies on the ground. In this way immense quantities of honey are every year taken. And this is generally the only reward the bee receives for the long labors of the summer. In the autumn we suffocate them with the fumes of sulphur, and ourselves revel upon the sweets which they had collected for their winter stores.

MANAGEMENT OF BEES.

It is agreed by the most judicious observers, that the apiary, or place where bees are kept, should face the south, and be situated in a place neither too hot nor too much exposed to the cold; that it be near the mansion house, on account of the convenience of watching them; but so situated as not to be exposed to noisome smells, or the din of men or cattle; that it be surrounded with a wall, which however should not rise above three feet high; that if possible a running stream be near them; or if that cannot be, that water be brought near them in troughs, as they cannot produce either combs, honey or food for their maggots without water; and that the garden in which the apiary stands be well furnished with such plants as afford bees plenty of good pasture. Furse, broom, mustard, clover, heath, &c, have been found excellent for this purpose. Hives have been made of different materials, and in different forms, according to the fancy of different ages and countries. Not only straw, which experience now proves to be rather preferable to anything else, but wood, horn, glass, &c, have been used for the construction of them. Single box hives, however, when properly made, answer very well, and when painted last long. They have several advantages above straw hives; they are quite cleanly and stand upright; they are proof against mice and are cheaper in the end, for one box will last as long as three of them. They are however rather colder in winter; but a proper covering will prevent all danger from that quarter. Straw hives are easiest obtained at first, and have been used and recommended by the best of bee-masters. If the swarm be early and large, it will require a large hive, but if otherwise, the hive should be proportionally less. If the bees appear to want more room it can easily be enlarged by putting a roll or two below it; but if it be heavy enough for a stock-hive, it will do although it should not be quite full of combs. Any person (says Mr Bonner) who intends to erect an apiary, must take particular care to have it filled with proper inhabitants. He must be particularly attentive to this, as all his future profit and

pleasure, or loss and vexation, will in general depend upon it. He must, therefore, pay the utmost attention to the choice of his stock-hives; for the man who takes care to keep good stock-hives will gain considerable by them, but he who keeps bad ones will, besides a great deal of trouble and little or no success, soon become a broken bee-master. In September every stock-hive ought to contain as much honey as will supply the bees with food till June following, and as many bees as will preserve heat in the hive, and therefore resist the severity of a cold winter, and act as so many valiant soldiers, to defend the community from the invasion of foreign enemies in the spring. They should be full of combs, and well stored with bees and honey, and should weigh at least 30 pounds each; if heavier, so much the better; for light hives run a great risk of perishing by famine, unless the bees are well supplied with food, whereas a well chosen hive of 30 pounds weight, allowing 12 pounds for the empty hive, comb, bees, &c will contain 18 pounds of honey, which will supply the bees with food till June; a time when it may be presumed they will find abundance of provision for themselves among the flowers. When a choice can be obtained, the youngest hive should always be preferred, because old hives are liable to vermin and other accidents. But although a hive should be four or five years old, it should not be rejected, if it possess these two essential qualities, plenty of bees, and plenty of honey.

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SCIENTIFIC TRACTS.

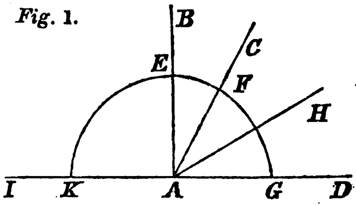
VOL. II......NO. XVI.

SURVEYING.

In the solution of questions appertaining to the art of surveying, it is undoubtedly most proper, where great accuracy is required, to make use of those methods of calculation which (setting aside accidental mistakes) lead to results that cannot differ from the truth. But there is a mechanical way of solving these problems, almost universally employed by practical surveyors, which, if carefully performed, is susceptible of great accuracy, and is recommendable on account of the extreme facility with which many operations may be performed, that are extremely protracted and difficult by other modes of resolution. It is our intention in this memoir, to elucidate in a popular way this mechanical method, and to give directions for the surveyor in the field; considering that we particularly address those to whom this art is unknown, or at least not at all familiar: but we suppose them possessed of a tolerable share of general information, and to know very well what is meant by a square, by parallel lines, and other like things; though they may not be well able to express what they understand by them.

The preliminaries, therefore, necessary to be given before considering the subject in our way, are very few.

Fig. 1.



An angle is the opening between two lines which meet each other and is greater or less according as the two lines open more or less, (no matter what may be their length). Thus

the opening or angle CAD (fig. 1) is greater than the angle BAC. If we place one point of a pair of dividers on A, the place of meeting of the lines AB and AD, and mark out or describe part of the circumference of a circle EFG, we shall find that FG will be as much greater than EF, as the angle CAD is greater than the angle BAC. For instance, if the angle CAD is twice as large as the angle BAC, we can draw a line AH, dividing the angle CAD into two equal parts, each of the size of the angle BAC, then FG will be double EF. If the line AB should happen to be perpendicular to AD, as is here represented, then the part of the circumference or arc of a circle EFG described between the two sides AB and AD of the angle, will be a quarter of the circumference of a circle, and the angle BAD will be a right angle. If the opening of the two lines AE and AI should be so great that CF and AI should make a continued line with AB, then the arc HEFG will be half the circumference of a circle; and the angle contained between the two lines, if it may be called such, is two right angles.

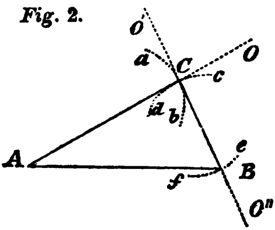
Now the circumference of every circle, great or small, is considered as divided into 360 degrees (marked °), each degree into 60 minutes (marked ′), each minute into 60 seconds (marked ″), and so on; and we say that an angle is of so many degrees, or of so many degrees and minutes, &c, according as the arc described between the sides of the angle contains so many degrees, or so many degrees and minutes, &c, of the 360° of the circumference of the circle of which this arc is a part.

A protractor is an instrument for measuring an angle, or for forming an angle of any magnitude at a given point on a line.

If we wish to measure an angle, we place the centre of the protractor on the corner or vertex of the angle, and one half of the straight edge on one of the sides of the angle, and if the other side does not project beyond the arc of the instrument, it must be produced or made longer till it does; then the number on the protractor exactly over this line will be the number of degrees in the angle; and will be more or less than 90°, according as the angle is greater or less than a right angle.

If we wish to form an angle of a certain number of degrees at the end of a line, we place the centre of the instrument at that end, and one half of the straight edge on that line, and mark the paper under this number of degrees on the protractor, then draw a line to this mark, and the angle formed will consist of the number of degrees required.

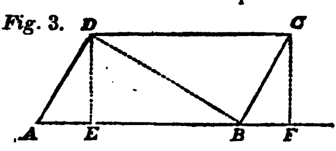
Fig. 2.



A triangle is a space surrounded by three straight lines; as ABC (Fig. 2), which is surrounded by the lines AB, AC, and BC. The sum of all the angles ABC, ACB, and BAC contained between the sides of a triangle, is equal to two right-angles, or 180°, as we may find by the protractor.

Any figure of four sides and four right angles, we shall call a square figure. The space contained in a square figure, or its content, is found by multiplying its length by its breadth, as is plain if we suppose the sides divided into equal parts, and the opposite points of division joined; for then the length multiplied by the breadth, in the denomination of these small divisions, will give the whole number of the small squares thus formed.

Fig. 3.



Any four-sided figure, whose opposite sides are parallel, is called a parallelogram; as ABCD (Fig. 3). The content of a parallelogram is formed by multiplying its length by its breadth; for if from the corner D, we draw the line DE perpendicular to AB, and place the triangle ADE, thus formed, on the other end of the parallelogram, as is represented, we shall form a square figure EFCD, of the same length and breadth, and this square figure is measured by multiplying its length by its breadth.

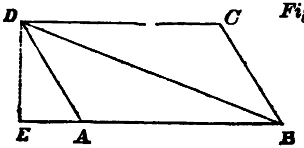


Fig. 4.

The content of any triangle ABD (Figs. 3 and 4), is found by multiplying any side AB by half a perpendicular CD, drawn to this side, or to this side produced as in Fig. 4., from the opposite corner D;* for any triangle ABD, (Figs. 3 and 4), is half the parallelogram ABCD, the content of which is found by multiplying AB by DE. To prove that the triangle ABD (Figs. 3 and 4), is half the parallelogram ABCD, we put the triangle BCD on ABD, by placing the sides CD on AB, CB on AD, and BD in the one, on BD in the other, the two triangles will then coincide.

The content of a circle is found by multiplying its circumference by half a line drawn from its centre to the circumference; which line is called the radius of the circle. When we know the radius of a circle, the circumference may be found by multiplying it by 6,2832, for the circumference of a circle is always about 6,2832 times its radius, as we can find by trial.

Every triangle, as we see, has three sides and three angles. If we know any three of these, except the three angles, the other three may be found. Thus, if the sides were 108,88, and 54, whether miles, rods, feet, or any other measure, we take AB (Fig. 2) from a scale of equal parts equal to 108 divisions; open the dividers so that the points shall be distant 88 divisions; place one of the points on A, and describe a small arc *ab*, with the other point; then take 54 divisions in the dividers; place one point on B, and describe a small arc *cd*, cutting the former in C; draw two indefinite lines from A and B through C, and AC will be 88, and BC 54. We now can measure the angles by the protractor in the manner described. The angle at C will be found 96° 4′, at B 54° 7′, and at A 29° 49′. If

* The line AB is in this case called the base, and CD the altitude of the triangle. A perpendicular is drawn from a point to a line by placing one side of a small square on this line, and moving it till the other side touches the point, and then drawing a line along this side from the point to the given line; and this will be the perpendicular required.

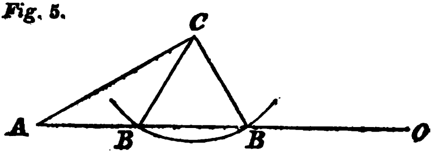
we know one side of a triangle to be 108, another 88, and the angle contained between them 29° 49′, we take AB (Fig. 2) from a scale of equal parts equal to 108; form an angle at A 29° 49′, as directed; make AC on the indefinite line AO 88, and draw a line from C to B, the extent BC, applied to the same scale of equal parts, shows it to be 54, and the angles at C and B, measured by the protractor, are 96° 4′ and 54° 7′ respectively.

If we know one side to be 108, an angle at one extremity of this side to be 29° 49′, and one at the other 54° 7′, we draw a line AB (Fig. 2) equal to 108, from a scale of equal parts, and make an angle at A 29° 49′, at B 54° 7′, and the indefinite lines AO and BO′ will cut each other at C. Applying the lines AC and BC, respectively, to the scale of equal parts, we shall find AC 88, and BC 54; and as the sum of the three angles of a triangle is 180°, we have only to add the angle at A to that at B, subtract their sum from 180°, and we have the angle at C 96° 4′.

If we know two angles and a side opposite one of them, we subtract the sum of the two angles from 180°, which gives the other angle; then we know a side and the two adjacent angles, as in the preceding case, and we find the other parts in the same way.

If we know one side of a triangle to be 108, another 88, and an angle opposite the greater 96° 4′, we draw a line AC (Fig. 2) equal to 88 from a scale of equal parts; make an angle at C, 96° 4′; then with the distance 108 in the dividers, we place one point in A, and describe an arc *ef*, cutting the indefinite line CO″ in B; draw the the line AB, which will be 108, and we shall find the line BC 54, the angle at A 29° 49′, and the angle at B 54° 7′. If, on the contrary, we know one side to be 88, another 54, and the angle opposite this last 29° 49′, we make AC (Fig. 5) equal to 88, from a scale of equal parts; we make an angle at A 29° 49′, and from the point C with 54, from the same scale

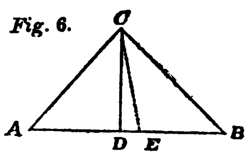
Fig. 5.



of equal parts, in the dividers, we describe arcs cutting the indefinite line AO in B and B′; then either of the triangles ABC or AB′C is the one required. In the one, the angle at B is found to be 54° 7′, that at C 96° 4′, and the line AB 108, and in the other the angle B 125° 53′, at C 24° 18′, and the line AB 44,7.

The reader will now be gratified to learn that he has finished the tedious part of the subject; and it is but justice to the writer, to observe, that he has a similar feeling. But a knowledge of what precedes is indispensable for our ulterior progress, and an acquaintance with these simple principles will enable us to make the most interesting calculations.

Fig. 6.



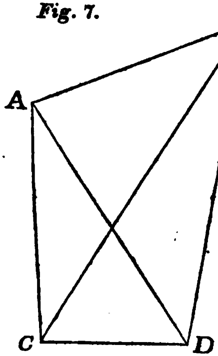
Being on one side of a river, and wishing to know the distance across, I measure along the bank a straight line AB (Fig. 6) 400 yards, about the distance that I suppose it is across the river,* or a little longer, and find the angles between this line, at each end, and a tree which grows on the opposite bank at C, with my compass. That is, the angle at A 50° 15′, and that at B 44° 30′. I now draw a line AB equal to 400 from a scale of equal parts, and finish the triangle ACB as has been directed. I place one point of the dividers on the point C, and describe an arc, the farthest part of which shall just touch the line AB, and this distance, applied to the same scale of equal parts, is 216,3. Therefore the distance across the river is 216,3 yards.

If I wish to know the distance of two trees, A and B (Fig. 6), being unable to measure the distance directly, but having access to such tree, I take a convenient situation C, and measure the distances CA and CB, which I find respectively 281,3 and 308,6 yards; and the angle at C I find 85° 15′. I construct a triangle with these parts, as has been directed, and find the distance AB, 400 yards.†

* Observe this proportion in all like cases, where it can be done. In fact, always make the angles and sides as near of a size among themselves as possible.

† The most of these examples we have taken from works on the subject, where they are solved by other methods.

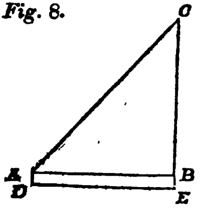
Fig. 7.



Wishing to find the distance between two inaccessible objects, A and B (Fig. 7), I measure a line CD 300 yards, as nearly parallel to the line joining the two points as may be, and differing as little as is convenient from it in length, I find the angle ACD 95° 20′, BCD 58° 20′, CDA 53° 30′, and CDB 98° 45′. From a scale of equal parts, I make CD 300; therefore, in the triangle BCD, I know the line CD, and the two angles BDC and BCD, with which I construct this triangle. In the triangle ACD, I know the line CD, and the angles ACD and ADC, with which I construct the triangle ACD. I now draw the line AB, which, applied to the scale of equal parts, shows the distance to be 479,8 yards.

If I have a triangular field, whose sides are 50, 46, and 40 rods, and wish to find in it a point equally distant from each corner, I construct the triangle; halve each side, and draw lines perpendicular to them. These perpendiculars all meet each other in the same point O, which is the point desired to be found. The length of the perpendiculars, applied to the scale of equal parts, shows them each to be 26,49 rods. I then have only to run a line at right angles from the centre of either side 26,49 rods, and the end of the line will be at equal distances from the three corners.

Fig. 8.



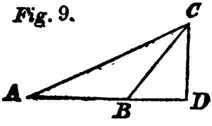
Wishing to know the height of a pole situated on a horizontal plane, I measure from it a direct line, ED (Fig. 8) 100 feet; it being, as near as I can judge, the same length as the pole has height, and find the angle BAC, or angle of elevation of the top of the pole, 47° 30′. The point A being five feet above the ground. I construct the

triangle ABC (Fig. 8), knowing the angle BAC to be 47° 30′, the angle ABC, a right angle, or 90°, and the side AB 100. Then BC, applied to the scale of equal parts which is used, shows it to be 109,13 feet. Adding BE, or five feet, the distance of my eye from the ground in taking the angle of elevation, gives 114,13 feet for the height of the pole.

We may observe here, that angles of elevation are usually and very correctly taken with a cheap instrument called the quadrant (commonly made of wood, with the face covered with paper) and is a quarter of a circle, the arc of which is divided into 90°. The degrees generally are quartered, and supposing the observer at the centre of the circle is numbered from right to left. A small round lead plummet is suspended by fine thread from the vertex, that is, at the centre of the circle of which this quadrant is a part. To take an angle of elevation, we turn down the ball of the compass-staff till it forms with the staff a right angle, and place on it the quadrant by means of a cavity in its back, in such a manner that the thread of the plummet may swing loosely. Place the eye at the end of the arc, and look along the upper edge to the object, the face of the instrument being turned to the right. Then the degree cut by the thread will be the angle of elevation. Angles of depression are taken in the same way; but the eye is placed at the vertex, and we look along the upper edge to the object.

If I wish to know the height of a pole or other object, CD (Fig. 9), whose foot is inaccessible, (the ground being level), at a station B, as near the foot as possible, I take the angle of elevation DBC, and find it 51° 30′; I subtract it from 180°, which gives 128° 30′ for the angle ABC; I then measure a direct line BA from the pole 75 feet, and take the angle of elevation DAC, which I find 26° 30′. With these things given, I construct a triangle ABC; I produce AB indefinitely towards D, and draw CD perpendicular to it. The distance CD, applied to the scale of equal parts, is 61,97. The height of the pole is therefore 61,79 feet.

Fig. 9.



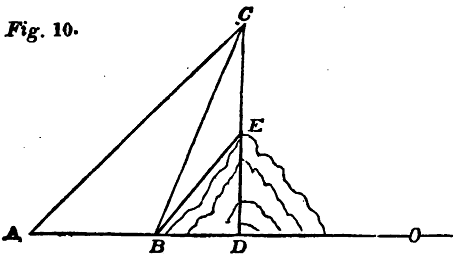


Fig. 10.

Wishing to know the height of a pole EC (Fig. 10), on a hill, at a point B, where I can see the bottom of the pole, I take its angle of elevation DBE, which I find 51°, and also that of its top DBC, and find it 67° 50′. I measure a direct line BA from the pole 134 yards, (the ground from B to A being level), and take the angle of elevation BAC of its top, which I find 44°. I subtract the angle DBC, or 67° 50′ from 180°, which leaves 112° 10′ for the angle ABC. I construct the triangle ABC, of which I know AB and the two adjacent angles, and draw CD perpendicular to AB produced; I draw BE, making the angle CBD 51°, and CE, applied to the scale of equal parts, shows the height of the pole to be 106 yards. The line ED, applied to the same scale, shows the height of the hill to be 107,4 yards.

If the ground descends or ascends regularly from the bottom of the pole or other object, I measure AB as before, and find the angles at B and A, and then proceed as in Fig. 8. Again, if the ground descends or ascends regularly from the foot of the object, which is inaccessible; at some point I find the angle of elevation of the top, and measure a direct line from the object, and again take the angle of elevation of the top, and then proceed as in Fig. 9.

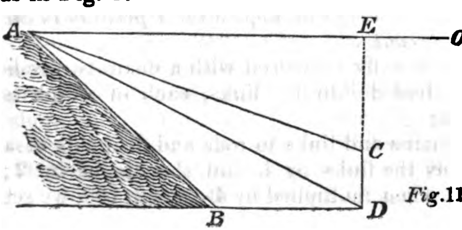


Fig. 11.

If I wish to know the height of an inaccessible object CD (Fig. 11), the foot of which is on a level with

the spot where I stand, (the ground rising regularly behind me); I measure a direct line BA from B, say 132 yards; here, with my quadrant, I find the angle of depression of the point B; that is, the angle BAE 42°; of the point D or angle DAE 27°; and of the point C or angle CAE 19°. I draw a line AB, making it 132 from a scale of equal parts, and draw an indefinite line AO, making with AB an angle of 42°, which is the angle of depression of the point B; an indefinite line BO′ is drawn parallel to AO and a line AD, making an angle 27° with AO; from the point D, where this line strikes BO′, a perpendicular DE is erected, and a line AC drawn, making an angle of 19° with AO. Then the distance CD, applied to a scale of equal parts, is 28,64; therefore the height of the object is 28,64 yards.

This is all that we shall say on the finding of distances and heights indirectly. It is believed that the intelligent reader will find it sufficient for almost any case that may occur, and we think that those who have not paid attention to this subject will be exceedingly gratified to be able to make so many pleasing and interesting calculations in so simple and easy a manner. We shall now show the method of measuring land.

The instrument used in finding the direction or course of a line, is usually a circumferentor, commonly called a compass, which is placed on a staff pointed with steel at the end, to be placed in the ground, and having a ball and socket at the other. We shall not describe these instruments, nor the manner of using them, as these things are best learned by inspection, assisted by a person acquainted with their use.

But it may be well to observe, that when the staff is set up, the ball should be directly over the line, and that the compass should always be kept level, *especially in the direction of its breadth.*

Distances are usually measured with a chain two rods long, which is divided into fifty links, each of which is 7.92 inches long.

To reduce chains and links to rods and decimals of a rod, we multiply the links by 4, and the chains by 2; but if the links when multiplied by 4 exceed 100, we set

down the excess above 100, and carry one to the chains. Thus 17 chains 21 links are 34.84 rods; 15 chains 38 links, 31.52 rods.

The wire of the chain should be strong, and *the handles should be of a triangular form.* Before using, in every case, we should measure it carefully, and see that it is precisely 33 feet long; for the length is always varying by the links getting crooked, which shortens it; or by the joints being partially separated, which lengthens it. The length of the links should also be equalized.

In running lines, the surveyor should be accompanied by four men; two to carry the chain; one with an axe to spot trees, drive stakes, &c, on the line; and one with a pole painted with some bright color, whose duty it is to place this pole perpendicularly on the spot which the surveyor directs. He should also have a hatchet, in fields covered with bushes and in woods, to lop the branches of such trees as intercept the sight of the surveyor. The man who carries the hinder end of the chain should be a person of some judgment; as he must keep the person at the forward end in a range with the object to which they are chaining, &c.

In surveying, each chainman should have a piece of leather an inch and a half broad, and nine or ten inches long, perforated with 16 holes, and sewed by one end to the collar of his coat or outermost garment; a small string eleven inches long is sewed to the top of this, and in measuring a line, at every twenty rods, this string is to be pulled through one of these holes, until the whole 16 are filled; when they are at the end of a mile. The string is then to be pulled out, and the same operation performed again. At commencing, the fore chainman has nine white sticks, made of ash or other limber wood, so that they may not be easily broken if stepped on. They should be 15 inches long. At the distance of the chain from the starting point, the hind chainman cries down, to which the fore one responds, at the same time pushing into the ground one of his sticks at the end of the chain, which must be drawn tight. They then continue on till the hind chainman arrives at the stick, when he cries down again; then the fore chainman puts down

another stick, and the one behind takes up the one left; and so on till the hind chainman comes to the last stick, when he as usual cries down. The one before, having no more sticks, cries tally, and puts his toe at the end of the chain. He is now 20 rods from the beginning of the line, and each draws his string through a hole of his leather strap. The hind chainman then advances and gives the one before, the nine sticks; both at the same time counting them, to see that none are lost. He then places his toe on the place of the other's, which is at the fore end of the chain. The one before then advances till he is at the length of the chain, when the hind man cries down, and so on as before.

The surveyor should carry a small blank book, 5 inches by 3, in a leather case, in which he must note with a hard pencil the courses and distances he runs, and anything else that may be necessary. He also must have a marking iron, and should put a mark peculiar to himself, on a tree or stake at the beginning and end of every line.

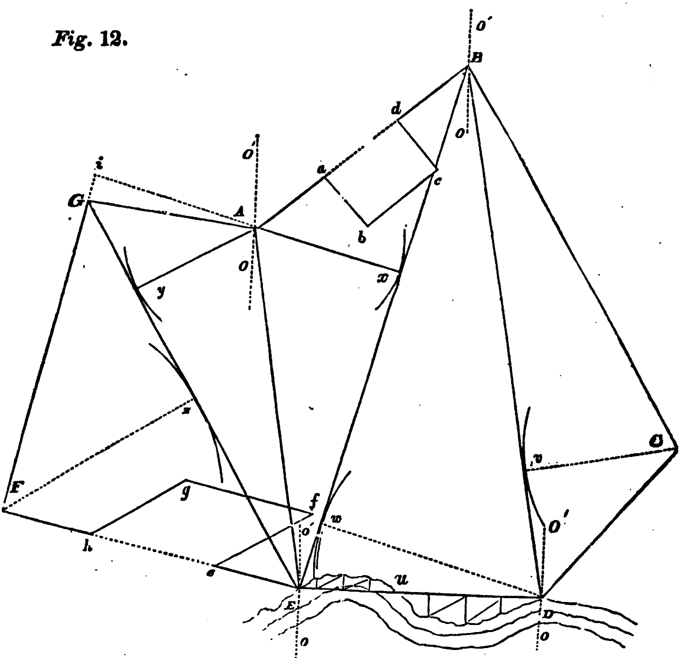
All inclined surfaces, as sides of a hill, must be measured horizontally, and not on the slanting surface. For this purpose the surveyor should be furnished with a measuring tape, which he can draw out to the length of the chain. In ascending a hill, the hind end of this is to be raised from the ground till it is on a level with the fore end, and must be held perpendicularly over the end of the preceding chain, (which can be done by means of a plummet and line). In descending a hill, the fore end must be raised to a level with the hind end, and a plummet suspended from it will show where the stick is to be put.*

Suppose that I have to run out and find the content of a tract of land of the form of Fig. 12. The places where most of the lines pass being known, but neither their length nor bearing. I commence, say at the point A, and find the bearing of the line AB north 50° east. But after having measured six chains to a point *a*, I find a pond, through which the chain-men cannot pass; I

* This may be 'professional quackery;' but it is *the only correct way*, (to say nothing of facility), which *I* have ever used, or indeed with which *I* am acquainted.

therefore move the sights of my compass to right angles with their former position, and order the pole-man to proceed to a point *b*, so that a line *bc*, run parallel to AB, will not touch the pond. The distance *ab* is

Fig. 12.



found to be 4 chains 40 links. I move the sights to their former position, and order the pole-man to proceed to some point *c*, from whence a line, run at right angles with *bc* or AB, will be clear of the pond, and find *bc* 6 chains. I run the line *cd* at right angles with *bc*, to the line AB, and then find *d*B 7 chains 10 links. The line A is therefore 19 chains 10 links. The corner C is inaccessible; but a tree being at that place, I take its

bearing, and find it S. 32° E., and also the bearing of the corner D, which I find S. 13° 44′ E. The distance from B to D is measured, and found 38 chains 23 links, and the bearing of C from D, I find N. 41° E. The line from D to E runs along the banks of a shallow and crooked brook; I therefore take the bearing of the corner E from D, and find it west; I direct the chain-men to measure the line DE; but at the distance of 2 chains, they find the perpendicular distance to the brook, 1 chain; at 4 chains, 1 chain 20 links, at 6 chains, 45 links, and at *u*, 8 chains 3 links. From D the line strikes the brook; at 10 chains 3 links, they find the perpendicular distance to the brook is 40 links, at 12 chains 3 links, 1 chain 5 links, at 14 chains 3 links, 35 links, and at 16 chains 43 links, the corner E and the edge of the brook coincide. I now take the bearing of the line EF, which I find N. 79° W.; but after chaining 6 chains, we are interrupted by a pond. Being unable here to offset at a right angle to the line EF, as I before did to AB, I run a line *ef* N. 60° E. to such a distance that a line *fg* parallel to EF, will not strike the pond, say 8 chains, and proceed on a line parallel to EF: that is, running N. 79° W. to a point *g*, so far that a line *gh*, parallel to *ef*, will be clear of the pond, say 9 chains; and then pass from *g* to *h* on a line parallel to *ef*; that is, running S. 60° W., and then we find the distance *h*F 6 chains 42 links. The line *fg* is equal to *eh*, as we may find by trial; therefore adding the parts E*e*, *fg* or *eh* and *hf*, I find the line EF to be 21 chains 42 links. The line FG passes through a swamp full of water, and its course and length I cannot find. I proceed from here to A, with the intention of finding the course and distance of the line AG, which passes through woods. The corner G is known, but the line cannot be traced; I therefore guess its direction as near as I can, and run a line A*i* N. 75° 54′ W., about 12 chains 43 links, and at this distance I find the corner G 1 chain 30 links to the left. I have the line A*i* 12 chains 43 links, *i*G 1 chain 30 links, and the included angle *i* or A*i*G a right angle; from which I construct the triangle A*i*G, and find the angle *i*AG 7° 06′. I must therefore run the line 7° 06′ more

southerly to strike the corner G; that is, I must run it N. 83° W. By proceeding on this course, I strike the corner very nearly, and find the distance AG 12 chains 48 links. I now proceed to construct the field, or protract it, as the operation is sometimes called. At a point A, I draw an indefinite line OO′ north and south; then, as AB runs N. 50° E., I make the angle O′AB 50°, and the line AB 38,40, from a scale of equal parts;* through B, I draw an indefinite line OO′, parallel to the line OO′, drawn through A, and as the line BC runs S. 32° E., I make the angle OBC 32°; I also make the angle CBD 13° 44′, and draw BD 76,92. Through D another indefinite line OO′ is drawn parallel to the former ones, and since the corner C was found to bear from D N. 41° E., I make the angle O′DC 41°, and as the line DE runs west, or at right angles to OO′, I make the angle O′DE 90°, and draw DE 33,72.

Again, drawing an indefinite line OO′ through the point E, as the line EF runs N. 79° W., I make the angle O′EF 79°, and draw the line EF 43,68. As the line AG runs N. 83° W., I make the angle O′AG 83°, the line AG 25,92 and join FG. The whole land now is protracted, and we have the shape of it in miniature.

To find what quantity of land this piece contains, or its content, the diagonal BD being drawn, I draw the diagonals EB, EA, and EG, and applying them to the scale of equal parts, I find EB 76,68 rods, EG 66,72 rods, and I have BD 76,92 rods, by measurement in the field.

I now place one point of the dividers on the point C, and describe a little arc with the other, the bottom of which shall just touch the line BD in *v*; and this extent, applied to the scale of equal parts, shows C*v* to be 20,64 rods.

I pursue the same method in measuring the other perpendiculars D*w*, A*x*, A*y*, and F*z*, and I find D*w* 32,40 rods, A*x* 23,40 rods, A*y* 18,84 rods, and F*z* 30 rods.

If I multiply BD by a half of C*v*, it gives me the content of the triangle BCD, and the areas of the triangles

* I reduce the chains and links to rods and decimals of rods.

BDE, BAE, EAG, and EFG are found, respectively, by multiplying EB by half Dw, EB by half Ax, EG by half Ay, and EG by half Fz: for, as we have said, the content of any triangle is equal to its base multiplied by half its altitude. The sum of the areas or contents of these triangles, it is plain, is the content of the field.

The operations are as follows.

76,92 rods, BD.
10,32 rods, half Cv.

15384
23076
7692

793,8144 square rods, content of the triangle BDC.

76,68 rods, EB.
11,70 rods, half Ax.

536760
7668
7668

897,1560 square rods, content of the triangle EAB.

76,68 rods, EB.
16,20 rods, half Dw.

153360
46008
7668

1242,2160 square rods, content of the triangle BDE.

66,72 rods, EG.
9,42 rods, half Ay.

13344
26688
60048

628,5024 square rods, content of the triangle EAG.

66,72 rods, EG.
15 rods, half Fz.

33360
6672

1000,80 square rods, content of the triangle CFG.

793,8144
1242,2160
897,1560
628,5024
1000,8000

4|0)4562,4888 square rods.

4)114—2

28—2

Thus we find the whole content to be 28 acres, 2 roods, and 2 rods. But in running the line DE from D to u, I left out a portion of the land, and from u to E, I included a portion which did not belong to the field. The area of the first portion is then to be added to, and of the second to be subtracted from, the above. The content or area may be easily found by dividing the four-

sided spaces into triangles, as is represented in the figure, and regarding the lines measured to the brook as bases of the triangle, and the distances of these lines as their altitude. The reader is left to perform the calculations.

Here it is proper to observe, that if we survey any field ABCDEFG (Fig. 12), and in plotting it we proceed from one point, say A to A again, if we perform the operation of protracting carefully, and if the end A of the last line HA should not fall on A, the beginning of the first line AB; that is if it should fall at some distance from it, the probability is that the lines were not measured correctly, or that their bearings were not properly taken. A re-survey should, in such a case, be made. Suppose that we have a large square tract of wood land (as Fig. 13), 6 miles square, for instance, to divide into 100 acre lots as near as may be; the land fronting north, south, east, and west, and the lots to be 200 rods from north to south, and 80 rods from east to west. The usual method of doing this, is to first go round the land, spotting the line anew, and when arrived at the point of departure, say at A, to measure towards B 160 rods, run a line south until the line DC is struck, and then to measure towards D 80 rods, and run a line north until the line AB is met, splitting the strip in two; and so on, until the land is divided into 80 rod strips. These lines are then crossed at right angles by others 200 rods distant from each other, and run in a similar manner. But by pursuing this course more than twelve miles are passed over before we know whether we have deviated to the right or left, and it is not at all strange nor *uncommon*, if, on reaching the original line of departure, we find ourselves twelve or fifteen rods one side or the other of the centre, where it is intended to strike.

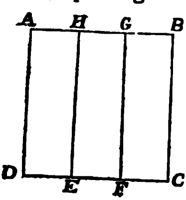


Fig. 13.

To obviate this, we start to go round the land say from A towards B, as in the other case, and make a peculiar mark on the line AB at every 80 rods, and on the line BC at every 200 rods, and again on the line CD

at every 80 rods; but after having passed to F, two miles from C, towards D, we run a line across to AB, meeting it at G, making a peculiar mark on this line at every 200 rods, except the first mark, which, in this case, must be 120 rods from the line CD (since six miles cannot be divided into parts of 200 rods each, the odd division being 120 rods.) After striking AB, we go on this line two miles towards A to H, and then run a line across to the line CD, which we shall find of course at about six miles from the line AB; having care to mark this line HE at every 200 rods. We now go on the line DC back to F, and from thence proceed round to A, marking the line FD every 80 rods, and the line AD at every 200 rods, except the first division, which, it is plain, must be made at 120 rods. We go back towards D to the first mark, which is at 200 rods from A, and run a line east to the line BC. When we get two miles, we shall strike the line running from H to E; we here search for the mark and see whether it is to the right or left of the place where we meet the line, and in running the next two miles, we favor the error. On arriving at the line GF, we see again by the mark on this line, whether we are too much on the one side or the other, and favor this circumstance in running the remaining two miles. On arriving at the line BC, we proceed to the next mark towards C, and run west in a similar manner. It ought to be observed, that these east and west lines should be marked at every 80 rods, to guide us in running our north and south lines.

By observing this course, we are able to make very straight lines through thick woods, where we are and must be from the nature of things, continually varying from the line on which we wish to continue.

We now flatter ourselves, that what has been said will enable the surveyor to perform all the operations incident to his profession, with the exception of those which consist in putting any quantity of land into a particular shape, of dividing it into determinate portions, and of determining the variation of the needle.

Suppose we have a quantity of land to lay out in an exact square, say 160 acres; we reduce it to square

rods, and then take the square root of this, which will be the number of rods in a side. Thus,

```
    160
      4
    ———
    640  roods.
     40
   ————
  25600(160 rods in a side.
  1
  ——
26)156
   156
   ———
    00
```

If we have a quantity of land, say 120 acres, to lay out in a square form, and have one side of this square figure; we reduce the quantity to square rods, and divide it by the side given (in rods), which say is 100 rods, and the quotient will be other side. Thus,

```
        120
          4
        ———
        480  roods.
         40
       ————
1|00)192|00
     ——————
      192  rods the other side.
```

Having a quantity of land, say 864 acres, to lay out in a square form; it being necessary to have the length to the breadth as a given quantity to another, say as 5 to 3; we reduce the quantity to square rods, divide it by these numbers multiplied together, take the square root of the quotient, and this multiplied by the larger number, gives the length, and by the smaller the breadth. Thus,

	864	
	4	
5	3456 roods.	96
3	40	5
15	15)138240 (9216(96 square rods.	480 length.
	135 81	
	32 186)1116	96
	30 1116	3
	24	288 breadth.
	15	
	90	
	90	

If we have a quantity of land, say 47 acres, 2 roods, 16 rods, to lay out in a square form, and it should be necessary that the length should exceed the breadth by a certain quantity, say 80 rods; we reduce the quantity to square rods, add to this the square of half 80 or 40, take the square root of the sum, and adding half 80 or 40 to this, gives the length, and subtracting the same sum, gives the breadth.* Thus,

	47, 2, 16	
	4	
40	190 roods.	96
40	40	40
1600	7616	136 length.
	1600	
	9216(96	96
	81	40
	186)1116	56 breadth.
	1116	

Having a quantity of land, say 2 acres, to lay out in the form of a triangle, one of whose sides is to be 30 rods, and the angle adjacent one end, 71° 15′. I draw a line AB (Fig. 14) 30, from a scale of equal parts, and

* The truth of these two last rules must be taken for granted.

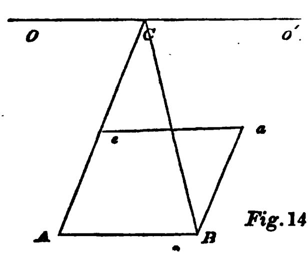


Fig. 14.

make an angle at A of 71° 15′. Then reduce the quantity of land to square rods, divide by 30, which gives half the altitude, double the quotient, and draw an indefinite line at this distance, (which is 21,333), cutting AC in C; join BC: ABC then represents the triangle, and AC, applied to the scale of equal parts, shows it to be 22,53 rods. Knowing these things, it is plain how we are to proceed to lay out the land. If the same quantity of land is required to be laid out in the form of a parallelogram, one side of which is to be 30 rods, and an adjacent angle 71° 15′; draw a line AB (Fig. 14) 30 from a scale of equal parts, make an angle at A 71° 15′, reduce the land to square rods, divide by 30, which gives the altitude, and draw a line *ea* at this distance, which is 10,66 from AB, making it equal and parallel to AB, and join A*a*. AB*ae* then represents the parallelogram, and A*e*, applied to the scale of equal parts, shows it to be 11,26. Knowing these things, it is obvious what course we are to pursue in laying out the land.

If we have a quantity of land lying in the form of a triangle, the base of which is given, and have occasion to cut off a certain quantity by a line running from the corner opposite the base, and striking it (the base); we divide the quantity to be cut off (in square rods) by half the altitude of the triangle* in rods, and the quotient will be the base of the quantity. Thus if the triangle ABC (Fig. 6) contained 650 square rods, and the length of the base AB was 40 rods, and it is required to cut off 290 square rods towards the angle B, we proceed in the manner following.

* Half the altitude of a triangle is found by dividing the content by the base; for multiplying the base by half the altitude, gives the area, as has been shown.

```
40)650(16,25 half the altitude AD.
   40
   ---
   250                          16,25)29000(17,84
   240                                1625
   ---                                -----
   100                                12750
    80                                11375
   ---                                ------
   200                                 13750
                                       13000
                                       ------
                                         7500
                                         6500
                                         ----
```

We must therefore measure 17,84 rods from B towards A to E, and then run the line EC.

If we have a triangle ABC (Fig. 15), containing, say 500 square rods, the base AB being 40 rods, and it is desired to cut off a triangle containing 200 square rods, by a line drawn from a point H on the line AC, 20 rods from A; we divide the content to be cut off by 20, which, considering AH the base of the triangle, gives 10, or half the altitude DE. An indefinite line OO′, drawn at double this distance from DC, and parallel to it cuts the line AB in a point E, to which the line must be drawn.

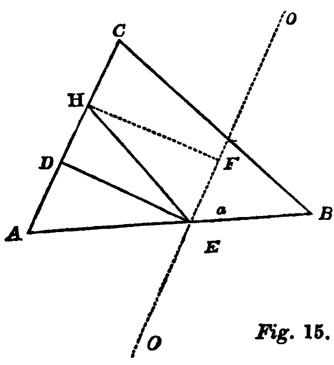


Fig. 15.

In the field, therefore, I run a line HF at right angles with AC, 20 rods; and then a line FE parallel to AC, till it strikes AB in E; and from E, I run the line EH, which cuts off a triangle AEH, containing 200 square rods.

If we have a triangle ABC (Fig. 15) containing, for instance, 500 square rods, whose base is 40 rods, and it is desired to cut off a triangle towards the corner A, containing, for instance, 150 square rods, by a line running parallel to BC; we say: as 500 is to 150, so is the

square of AB, or the square of 40, to the square of A*a*. We now take the square root of the result of this proportion, and measure this distance from A to *a*, and then run a line from *a* parallel to BC, which will cut off a triangle of 150 square rods.*

If we know the angle (say 50°) contained between two indefinite lines AO and AO′ (Fig. 16), and it is necessary to cut off a triangle containing a certain quantity of land, say 1000 acres, by a line running a given course, say one making with the line AO′ an angle of 70°; from a point B, at any distance from A, say 20 rods, we draw a line BC, making with AO an angle ABC 70°, and find the length CD of a perpendicular drawn from the point C to the line AO′, by applying it to the scale of equal parts; multiply AB, or 20, by half this length, and then say, as we did in the preceding case: as this sum is to the quantity to be cut off (1000 square yards) so is the square of AB to the square of AE. We take the square root, and measure this distance AE from A, and run a line EF parallel to BC, and it will cut of a triangle AEF of 1000 square rods.

Fig. 16

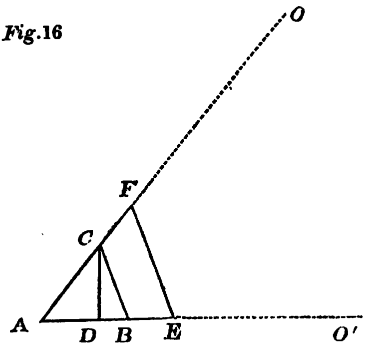
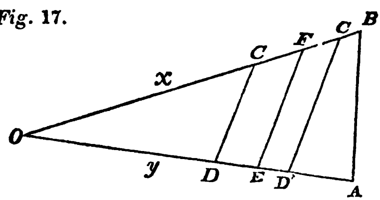
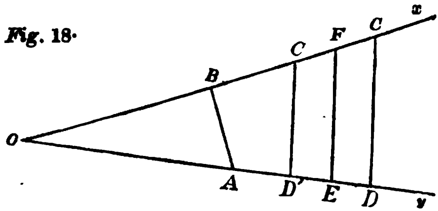


Fig. 17.



* The truth of this rule must be taken for granted.

Fig. 18.



Knowing the length of the line AB (Figs. 17 and 18), and the angles ABx and BAy in each, if it is required to cut off a four-sided figure of a certain magnitude by a line making a given angle with AO; we produce in either figure the indefinite lines Ay and Bx till they meet in some point O; we then find the content of the triangle AOB in either figure, and in Fig. 17, we draw a line EF, making the required angle with AO, and cutting off a triangle OEF, as near as we can judge, of such a size as may leave the remaining part AEFB of the required magnitude. If the remaining part is not of the required magnitude, as will almost always happen, we say, as the triangle cut off is to the part required to be cut off, to leave the remaining part of size desired, so is the square of OE, whose length may be found by applying it to the scale of equal parts, to the square of OD or of OD′. We take the square root of this, subtract it from AO, which gives AD or AD′, greater or less than AE, measure this distance towards O, and run a line parallel to EF, which will be the line required. We can now plainly see how we are to conduct in figures like Fig. 18. Indeed the principles made known in considering the question to which Fig. 16 has relation, will enable us, with a little ingenuity, to perform almost any operation in the division of land.

Suppose that we have a tract of land in the form of Fig. 19, the sides and angles of which are known, and it is desired to divide it into certain portions, say into two equal parts by a line running from F. We plot the field, draw a line from F to C, and find the content of each of the parts ABCF and CDEF; and supposing the portion CDEF the largest, we cut off from it a triangle

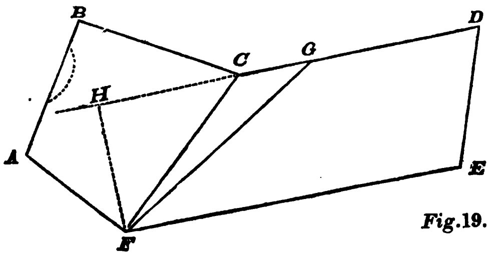


Fig. 19.

FCG equal to this excess; and this may be easily done by dividing this quantity (the excess) by half the altitude FH of the triangle FCG, which gives the base CG. We then have only to find the angle EFG with the protractor, and in the field run the line FG, making this angle with CF.

It may now be well to mention, that the compass needle rarely points to the true north in any place, but either to the east or west of it; and this variation of the needle from the north is not usually the same at any two places a little distant from each other, and is continually changing at the same place.

As this is the case, it is very important, that the surveyor may be able to determine it with facility and accuracy. The following method is very simple and sufficiently correct if carefully followed.

Place one foot of a pair of dividers on a smooth board, and mark several circles with different openings of the dividers. Erect at the centre of these a straight stiff wire perpendicular to the board, about as long as the radius of the greatest circle. A day that the sun shines this board must be placed with its upper surface horizontal; which, if it is of the same thickness throughout, may be affected by placing it on the surface of molasses, tar, or any other liquid not liable to be disturbed by the wind, and confining it so that it will not move. Observe, in the forenoon, when the end of the shadow of the wire just touches the circumference of one of the circles, and mark the place; in the afternoon we see when the extremity of the shadow just reaches the same circumference, and mark the place. A straight line drawn from the foot of the wire to the middle of the arc, contained between these two marks, is a north and south

line. This line may be lengthened out, and a wire placed perpendicular at its extremity. Then take the bearing of the two wires with the compass, and if the course be easterly of the north pointed out by the needle, the variation is so many degrees west, and *vice versâ*. Should he wish to find the true bearing of the several lines of the survey; that is, the bearing which they would have if there were no variation, if the variation should be to the west, it would be necessary to consider the line as running more to the left by the number of degrees in the variation, and if the variation should be to the east, he must consider the line as running more to the right by the number of degrees in the variation. Thus, if the variation were 14° to the west, and if a line were found to run by the compass N. 43° 25′ E. it would really run N. 29° 25′ E. If it run S. 1° W., it would really run S. 3° E. If one bore by the compass N. 30° W., and if the variation were 10° to the east its true bearing would be N. 20° W. If it bore S. 80° W., its true bearing would be west.

If we consider the compass as pointing to the true north, and do not notice the variation, it is obvious that the field when protracted, will be precisely of the same shape and size as it would be if the needle did not vary from the true north. Therefore in finding the area of a parcel of land, it is unnecessary to notice the variation. But since this variation as we have said is continually changing, the surveyor should determine it with all convenient accuracy before commencing his work, and note it very carefully in his minutes; in order that any person who might wish to make a resurvey of the tract, could by consulting these minutes, and by finding the variation at the time, determine exactly the course which they were formerly run.

These minutes also furnish means for determining the variation at any time with great facility: for by them we know the true bearing of any line in the survey: and by taking the bearing of this line, the difference from the true bearing is the variation.

Another thing yet remains to be said with regard to the variation of the compass: the near approach of any-

thing made of iron or steel is known to attract the needle from its proper position. All such implements should therefore be kept at a distance from the compass when we are surveying. But large quantities of iron ore are sometimes found, by which the needle is very materially affected. To guard against errors into which we may fall by not attending to the variation that such quantities of ore may cause, it is necessary at every new station to take a back view of the line which we have just passed over.

If the compass does not reverse truly: that is, if the line the surveyor has just passed over does not appear to have the same direction as it did at the former station, there is an attraction at the last situation, or else there was an error committed in taking the bearing of the last line at the other station. To determine which is the one he has only to proceed back and take the bearing again.

But if at the second station of a survey the compass is found not to reverse truly, and if there was no error made at the first station, it is more difficult to discover where the compass was affected. In order to determine at which place the attraction existed, we take the bearing of a distant object from each station, and from that object we take the bearing of each of the stations. Then if the line joining the object and one of the stations, appears to have the same direction when its bearing is taken from the object, as when taken from the station, the attraction existed at the other station. If this is not the case with either line, there was an attraction at both stations, but in different degrees or else there is an attraction at the object.

In running a long line if we find an attraction existing in any part, we can continue the line without the aid of the compass by placing two stakes upright on the line, and putting another upright in their range; the last may then be taken up and placed in the range of the two others, and so on. When the last method is resorted to it must be performed with great care: for if we at any time vary from the line, that variation continually increases.

When we find an attraction existing at any angle of

a survey, if the direction of the next line which is to be run can be seen, we are able to determine the angle, and of course the direction the line without the aid of the compass. For we have only to measure back on the last line a certain distance where we place a stake, and on the new line an equal distance, where we place another stake, and afterwards to measure the distance of these two stakes. Then we have their sizes of a triangle to find the angle.

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SCIENTIFIC TRACTS.

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INVENTION AND DISCOVERY.

In the early periods of the world, there were few motives to excite the enterprise and draw forth the invention of man. He existed in a region of country which contributed liberally to his wants, and scattered about him a wide profusion of the common blessings of life. Having dominion over the life of living creatures, with comparatively few wants to be supplied, man gathered without much labor, the fruits of the earth and the sea, with few incentives to vigorous enterprise. And thus it continues to be with many tribes of the human family in distant sections of the world. Necessity however has produced a great change in this respect among the millions which inhabit the earth. With the vast increase of population new resources of wealth and sustenance have been discovered, and the powers of Nature have been made tributary to the wants of man, to an extent far beyond the reach of the imagination. In the same proportion has civilization been extended from one nation to another, diffusing its blessed influences, opening the eyes of man to the glories of his Maker, and raising him to that dignity of which he is capable, by the immortal faculties conferred upon him by his Creator. The improvements which constitute the honor of the present age, which multiply the comforts and conveniences of life, and lighten the burthens of labor, are calculated, not to raise to opulence and ease the favored few, but to elevate the minds and increase the happiness of the great mass of intelligent beings. They are of a diffu-

sive size and benevolent character, and like the overflowings of the Nile enrich and fertilize all within their influence. Notwithstanding the influence and power of inventions and their value, it is seriously doubted by many individuals, whether on the whole, what are denominated labor-saving-machines are a benefit to the community. It is said that the hand of industry is palsied by these, and our population is growing up to habits of idleness; and ignorance, vice, and pauperism are spreading through our towns and villages. This objection, however, loses its power by even a superficial examination.

It is not a fact that industry is discouraged, for just in proportion to the rapid increase of improvements and inventions in the mechanic arts, has been the demand for labor, and the corresponding increase of wages. True, in some parts of the world where there is an immensely dense population, we have heard the cries of distress, and learnt of the sufferings of the laborious classes, and their highhanded rebellions against their employers, the destruction and waste of their property have been the melancholy results.

But has this state of things sprung up legitimately from the use of inventions? Have not other causes contributed to produce poverty, wretchedness and disease among the operators of large manufacturing establishments? Is not the real cause to be found in the bad political institutions of the land, in the partial and unequal system of laws, by which these communities are governed, and last, though not least, in the oppressive taxation which grinds the faces, and eats up the substance of the poor? Let the principles of freedom become universally diffused and wholesome laws promulgated, and the simplicity of our republican institutions obtain general currency, and those who are now pressed down to the dust by their enormous burdens, will rise to a comfortable independence of life and intellect.

It cannot admit of a doubt that every improvement, by which the means of sustenance, or clothing, or merchandize are produced by a small amount of labor, is a blessing to a community, and goes to increase the amount of

wealth and happiness. And though this be admitted by the shrewd and intelligent investigators of political economy, yet it is scarcely assented to by the yeomanry of the land. How often is it gravely said that cotton, or linen of household fabric, is far more durable than cloth manufactured by machinery, or water power; and the inference deduced from this position is, that the latter is less valuable, though cheaper, and that the daughters of farmers are deprived of the means of wholesome labor at home. With wo-begone countenances and a long drawn sigh, have we heard manufactures deprecated as a curse to the land in wealth and morals, and their multiplication dreaded as indicative of the future downfal of the country. Now to arrive at a correct decision in this case, it should be clearly ascertained, how much a yard of cloth costs of household fabric, and this expense should be compared with the cost of a yard produced by water-power, and though it should be proved there was a difference in the texture and strength, in favor of the former, if the expense of one yard at home would purchase 3, 2, or 4 yards at the factory, the decision is in favor of the latter method of producing cloth. But this question is settled by the fact, that this branch of business is almost wholly relinquished in the house at the wheel, and prosecuted with a vast amount of capital and a fair profit in our public establishments.

But it is said, there is a lamentable defect in the education and the morals of these communities of individuals, which is unavoidable. That many of the youth are entirely without education and absolutely abandoned to vicious practices.

In reply, it may be said with truth, that the want of good education and good morals is not necessarily connected with such employments, but depends on other causes altogether within the control of the owners. And in a country which holds out the means of common education to all the children indiscriminately, of the rich and the poor, and where such ample means of biblical instruction are furnished, by the hand of christian benevolence, where it is an honor to enlighten the ignorant and reform the vicious, and teach the child of tender years

what are the first principles of the oracles of God; every child has the opportunity of acquiring knowledge suited to present existence, and that fear of God, which will prove a safeguard against the temptations of the world.

There is a proneness in mankind to deal in wholesale remarks for or against improvements, whether mechanical or scientific, without regard to the real merit of invention, or the judgment of the discerning.

With some, all advances upon the labors, or changes in the habits of former generations are deprecated, as innovations not to be tolerated. *They* would follow in the steps, and observe the practices, in which they were educated. With others, all is imagination, and they have many day-dreams of prosperity and advancement, and engage in pursuits with more energy than wisdom, without calculating the probabilities of a defeat; and the first evidence of their discretion is the entire prostration of all their schemes. Each of these extremes is to be avoided.

Improvement in the arts is eminently characteristic of the present age, and progress in the sciences is constantly made, amply unfolding the vast powers of the human mind and contributing to the various necessities of man.

Although most inventions of great public utility have overwhelmed the ingenious authors, or plunged the skilful artists in pecuniary embarrassment, and thrown them into prisons for the wonderful development of their faculties: yet subsequent generations have reaped the reward of their industry and perseverance, and honored the name of him, who furnished the means of their wealth. The world has often cold charity for its greatest benefactor; and the man of inventions, of strong mechanical powers, of untiring industry, must be contented with a small pittance, and derive his reward from the gratification of his own disposition in his favorite pursuit. When devotion to any particular source of wealth is exhibited, and the undertaking is carried forward with zeal, when it enlists the feelings and commands the resources of large portions of the community, both the rich and the poor, it is by many regarded in the light of speculation, as a hazardous exploit, and they are heard to

say, this employment, or that enterprise, is carried too far — where will it stop? It is a monopoly which will swallow up other vocations, and draw off men from other and surer interests, and bring upon us a long train of sore calamities.

Where will it stop? The answer is to be found in the foresight and understanding of those concerned in such enterprises. Time regulates the affairs of men.

When by any stagnation in the circulating medium, or unusual depression in the great interests of the country, as will be the fact occasionally, then will there be necessarily a check to the vast manufactures of New England, till by a reduction in value, and the consequent withdrawment of capital, and a devotion of it to different pursuits, the wheels of this vast machine are again set in motion, and the pulse of life beats stronger and is more uniform in its action.

These engrossing objects of public attention, and their prosperity, and the danger of depression, and the cure for existing evils, all go along together and regulate themselves. So that all extraordinary grief and anxiety in those not immediately concerned is work of supererogation. All our fears may be laid aside, for be assured these objects will not be prosecuted with much zeal when they cease to be profitable. Self interest is a powerful principle in regulating the commercial transactions of men, so that the multitude of us may rejoice in the prosperity which crowns the labors of our citizens, and be grateful to God for the blessings of his Providence, and be careful to improve them acceptably, in cultivating the powers he has given us and exerting a healthful moral influence in the various departments of life.

The question still presents, are labor-saving-machines a benefit to the community? The answer is in the affirmative, but if any are inclined to the negative, they have but to ask, What are such machines? and when and where used? They are found in every department of life. A plough is one. What could be done without this valuable implement of husbandry? Does any person doubt its utility who sees the summer harvest waving in the southern breeze, and the hills covered with corn? a

spinning wheel is another labor-saving-machine, for in China to this day, the natives twist thread with their fingers.

The art of printing with metalic types, was a great invention to save labor; for it was the custom to print with wooden blocks and carved types of the same material, cut out of the block. Will any one person throw away his books, and sigh for the age when blocks were used for printing, lest he should be found to encourage labor-saving-machines. Here it might be shown that the demand for human industry has not ceased, but is greatly augmented in consequence of the introduction of machinery. It is difficult to conceive what was the state of society when there was no printing, or when the art was partially known. We can almost as easily imagine the condition of the world when there was no light? Yet we know that there was such a time. Then the copyist performed the printer's work. Books were published by copying them out with a pen. A considerable number of persons were employed in this business, and more found employment in the preparation of materials for copying. Books were very expensive. The whole annual income of a man in moderate circumstances would hardly buy a bible. None but princes and very opulent men could afford to purchase libraries. Hence the demand for books was extremely limited, and the number of persons employed in furnishing them must have been regulated by the state of the demand. When the printing press was introduced, an extensive change took place. Books were multiplied. The price fell. Readers became more numerous. The demand for information became more urgent. Knowledge began to diffuse her healing beams every where, and an impulse was given to society that has ever since continued to grow in energy and power. And what has been the effect of this machinery upon human industry? Is there more or less of human labor employed in furnishing books, since the press has lent its mighty aid to the work, than before?

Where was then one author, there are now at least one hundred. It has been calculated that in Germany, one out of every hundred of the population is an author. The

whole business of publishing through its various processes from the paper-maker to the purchaser, employs many hundred times as much human labor as it did before the printing press was invented. It is not possible for the demand of human industry to be diminished till every department is filled — till industry shall have subdivided itself into the greatest possible number of departments, whether moral, or intellectual, or physical — and every want of man more than supplied. This can only happen when man shall cease to improve.

The business of printing calico was formerly done with blocks of wood. These blocks were made and figures were stamped at a dear rate, now it is done with rollers at a mere fractional part of the expense. Shall the ladies lay aside their dresses, because the fabric of which they are made is manufactured at a smaller expense? The principle however of opposition to labor-saving-machines amounts to this; and whoever enters the lists against them, and throws down the gauntlet, and defies an argument to prove their utility, must first carefully look about his house and see that nothing there is made with machinery; and he must examine his implements of work and ascertain that none of them saves him a vast amount of labor. And when he is comfortably seated by his fireside reading his newspaper, let him stop and ascertain whether that chronicle, once the faithful herald of a noisy world, but now, alas! too much the caterer of vicious appetite — was not printed with a steam engine; and let him ask himself whether he is not encouraging labor-saving-machines by paying for the means of his own improvement.

To be honest in principles, he must do this. This was the spirit of our ancestors which was manifested in their stern resistance to the oppressions of the British parliament, they did nothing to countenance principles subversive of liberty and detrimental to the country. The comforts of life were relinquished, and the means of improvement given up, where their enjoyment was procured at the expense of principle.

So it should be as to encouraging any progress in the arts, if seriously convinced that their use is fraught with

mischief to the country. However men may differ in theory upon this subject, they agree in practice, and will avail themselves of the advantages of science and the mechanic arts, so long as improvement in these things continues to be made.

There have not been wanting persons in every region who have deprecated changes in almost every department, and improvements however beneficial. It is vulgarly said, why not keep on in the old beaten track, and follow the maxims and ways of our fathers? Why indulge so many idle phantasies and trouble the world with your notions? And besides, say they, your changes make people tender and effeminate, and weaken their muscles, and take away their strength. O! for the times and men of past generations. — There are those who with a melancholy melody harp these strains.

Improvements in the arts have been deprecated, but the power of habit must yield to what experience tells us will promote the comfort and usefulness of man.

The time was in England when the people lived in houses made with reeds and clay, and enjoyed as much happiness as their limited knowledge and scanty invention would permit. The oak and other valuable timber was choicely kept for the king's ships, consulting rather the defence of their country than individual convenience, and presuming that the growth of these materials might be checked and there would be no navy.

As the people became wiser, oak was used in the construction of their buildings, and framed houses were substituted for clay ones. This however was an improvement in building too great to be tolerated, and was considered out of all reason and prognosticated severe judgments. Many persons laid it seriously to heart, and greatly deprecated the influence of tight rooms upon the human body, and feared the paralyzing influence of confinement on the wind, and anticipated the time when wooden houses would be diminished, and the people would return to live in their mud-walled huts.

Grievous were their remonstrances and doleful were their complaints against the innovations of the age. O, these degenerate fashions and still more degenerate sons of

England! how have they fallen from the hardihood of their fathers! Time was when men lived in clay houses with oak hearts; now they live in oak houses and have clay hearts. So late as the ninth century, by reason of the unskilfulness of the carpenters in Great Britain, their buildings were full of crevices, and hangings or curtains were used then as a necessity as much as a luxury, since they served to keep out the wind and make their apartments more comfortable. The construction of their houses was so defective that Alfred the Great, to perserve his lights from the currents of wind, even in the royal palace, was obliged to have recourse to the invention of lanterns. Their furniture too was out of all good taste, for while their tables and secretaries were made of costly materials, their seats were coarse benches, and wooden stools.

Now what has been the effect of inventions upon the strength of the nation? Are there not as brave warriors, and vessels as numerous, and is there not a navy as much to be feared as in the days of the Norman conquest? Is there not as much bone and muscle now as in the days of England's proudest glory? Certainly all fears of deterioration were imaginary.

From the days of the Anglo Saxons to the time of Sir Christopher Wren the father of English architecture, improvements have been hooted at; and that great genius was compelled to suffer deep and distressing embarrassments for building the large cathedral, before he received the scanty wages which had been promised him, so long and loud was the popular clamor against new things.

It were easy to show more fully that inventions and improvements in the various branches of human industry and in the sciences, are rich blessings to all classes of individuals, and without them some portions of this earth, so dense is the population, would not sustain the inhabitants. That which benefits one great class in the community, without any extraordinary protection for that interest, to the disparagement of others, proves beneficial to other great classes. So that the merchant and husbandman, the mechanic and manufacturer, may rejoice in each other's prosperity with the assurance that their interests rise or fall together. To prove this however is not the

object of this tract. We have said the world has cold charity for many of its greatest benefactors, and it does appear that the man of inventions and skill has been compelled to receive but a small share of its bounties, and look for his reward in the gratification of his favorite pursuit. I know there have been a few exceptions to this remark; and we earnestly hope the time is not far distant when a just estimate will be made of talent, however obscure its origin, and when it will be the glory of the age that it has substantial rewards for ingenuity, and lasting honors for the benefactors of mankind.

What does history tell us of the treatment the wise and learned have received for their discoveries? Take a few examples.

1. Galileo. He was born 1564 and died 1642, the year Sir Isaac Newton was born. This man gained immortality by his discoveries and researches in Natural Philosophy. He was distinguished by a wonderful spirit of observation, and when only nineteen years old the swinging of a lamp suspended from the ceiling of a cathedral, led him to investigate the laws of the oscillation of the pendulum, which he was the first to apply as a measure of time. The hydrostatic balance was his invention, and he was constantly engaged in asserting and defending the laws of nature against a false and perverted philosophy. At an early age he was professor of philosophy and lectured with unparalleled success. Scholars from the most distant parts of Europe crowded about him.

The mathematical truths he discovered were of the highest importance; for example, the fact that the spaces through which a body falls in equal times, increase as the numbers, 1, 3, 5, 7, that is, if a body falls fifteen feet in one second it will fall forty five feet in two seconds, and seventyfive in three seconds and so on. Whether the thermometer was his invention it is difficult to determine, he may have only improved it. Some interesting observations on the magnet were made by him.

The telescope, which in Holland remained not only imperfect but useless, Galileo turned to the heavens, and in a short time made a series of the most important discoveries. He found that the moon like the earth has an

uneven surface, and he taught his scholars to measure the height of its mountains by their shadow. He discovered Jupiter's satellites and observed Saturn's ring. He saw the spots on the sun somewhat later, and inferred from their regular advances from East to West, the rotation of the sun, and the inclination of its axis to the plane of the ecliptic. His name became so celebrated that he received distinguished honors. He gained a decisive victory for the Copernican system in 1610, by the discovery of the motions of Venus and Mars about the Sun. A book was written by him on the floating and sinking of solid bodies in water, and in this, as well as in all other of his writings, he has scattered the seeds of many new doctrines with a munificent hand. The greatest work which ever came from his pen, was a dialogue in which three persons are introduced.

The first, a defender of the Copernican system. The second, an advocate of the Ptolemaen system; and the third, a person who examines the arguments on both sides.

The conclusion is strikingly in favor of the first, or Copernican system. With this elegant and proud work Galileo had united the clearest arguments, and printed it at Rome the very seat of the false systems of philosophy.

This was an innovation upon the old principles; this was an improvement of former systems, which called forth the most inveterate, implacable hatred of the great and learned. They attacked his principles without mercy, and unable to everthrow them turned their animosity against the author.

What was the reward of his persevering labors which have so enriched the world, and placed Galileo on a high nitch in the temple of fame? Did he live in affluence and enjoy a literary fame, with learned companions, his blushing honors clustering thick around him? No! — He was seized by a power he could not control, and compelled to languish months in the prison of the inquisition at Rome, and afterwards confined in her dungeons, and every week for three years, was forced to repeat, what was called the seven penitential psalms of David. He was afflicted in his sight and lost an eye, and the other

became useless when he discovered the libration of the moon. Blindness, deafness, want of sleep and pain in his limbs, united to embitter the last days of his life.

In my darkness (says he) I muse now upon this object of nature, now upon *that*, and I find it impossible to soothe my restless head, however much I wish it. This perpetual action of mind deprives me almost wholly of sleep. He died aged 78, in the arms of his youngest and most attached scholar; and at Florence, a splendid monument is erected to his memory.

2. COLUMBUS. Behold this great navigator of oceans and discoverer of continents, follow him through a long and perilous and trying life, and think of the good he accomplished, and the miserable rewards of his valor and daring enterprise. At one time blasted in his hopes, frowned upon and crushed in his expeditions by the King and Queen of Spain, and loaded with manacles and chains by the very persons who should have patronized him. At another time, see his companions conspiring against him, to destroy his life, having no patience to share his toils and no hope of final success, and this too at a season when the natives were in arms against him. Despair with its hideous train of evils was impressively marked on the countenance of his fellow voyagers, and they expected to yield up their life, as the result of his bold exploits.

With everything to cramp his genius, and quench his ardor, and break down his constitution, Columbus overcame the severest trials by the persevering constancy of his devotedness to the great objects of his ambition and to the gratification of his unconquerable native propensities. What he could not effect by argument he accomplished by stratagem, by seizing upon the ignorance or superstitions of the natives on the islands of his misfortunes. When finally worn down with the various obstacles and impediments in the way of his success, when he most needed encouragement to revive his drooping energies, the king of Spain utterly refused to fulfil his contract. After two years of exhaustion, sickness, humiliation, and despondency, he died in the seventieth year of his age.

What great boon? what substantial reward did this

mighty discoverer, this great man who did more than any other person to change the face of the world, receive? not enough to secure the safety of his person. Not enough to free his mind from distressing solicitude concerning the means of support. Base ingratitude was the reward of his invention, and the recompense of his toil. The marks and instruments of torture, he carried with him to his grave. The chains which he had worn he kept hanging in his cabinet, and requested that when he died, they might be buried with his body.

Monuments have been erected to his memory, and his remains within half a century have been deposited with solemn pomp, in a magnificent cathedral. But how useless is this distant respect to his worth and of what service could it have been to him, had he foreseen this regard in the long vista of the future?

In the vigor of manhood Columbus was of an engaging presence and of an elevated and dignified demeanor. Care and trouble turned him gray at thirty. He was noted in life for a strict devotion to moral duties, and for enthusiastic engagedness in the ceremonies of his religion. Of a great and inventive genius and lofty and noble ambition, his conduct was characterized by the grandeur of his views and the magnanimity of his spirit.

We might pause here, and weep at the ingratitude, and sigh at the depraved selfishness of man, when memory recalls the treatment this distinguished man received from those who should have been the patrons of science and the promoters of discovery. But grief will never reform the world. There must be a high and pure intellectual and moral devotion of character, before the chains of avarice will be broken and mankind will realize that the laborer is worthy of his hire, whatever may be his sphere of duty.

3. In the history of Dr FRANKLIN, we have the case of a powerful genius struggling with poverty. His lofty and aspiring mind could not be confined to the ordinary pursuits of life, but must feed upon something suited to its enlargement and expansion. Hence, he sought employments which made him familiar with books, and where the natural bent of his intellect had ample scope

for its gratification. Yet how difficult were the means of his advancement, how hard was it for him to enjoy the facilities for the cultivation of his noble powers. For a season his way was hedged up with obstacles requiring strong resolutions and obstinate perseverance to overcome them. Think of him wandering about in the streets of Philadelphia, with his pockets filled with shirts and stockings, and his roll of bread in his hand, and dark discouragement ready to prey upon him, and no kind friends to stay up his spirits, or assist him in his occupation. Follow him till his introduction to the Dutch Governor, and see his countenance radiated with hope and his heart filled with joy at promised encouragement. When apparently nearest the object of his desires, it vanishes and eludes his grasp. With fair promises of patronage from the governor, he went to England with letters from his chieftain; follow him across the Atlantic to the city of London, a stranger and in a strange land, with letters to distinguished men whom he supposed would enter heartily into his plans and furnish the means of gratifying his own native propensities. What must have been his chagrin, how sad the disappointment, to find on opening the letters, they had no relevancy or connexion whatever with the business or employments of his mission. How poorly was his perseverance rewarded by the base deception of the Dutch Governor of what is now one of the largest states in the union? The native strength of his own mind elevated him above the discouragements of early life, and urged him forward in the pursuits of science.

'Who would have dreamed that this poor wanderer in a foreign land, without resources and without friends, would become one of the legislators of America, the ornament of the New World and the pride of modern philosophy?' He was indebted to his own original enthusiastic devotion to politics and the arts for all the progress which he made in them; and America rewarded him by her honors rather as a necessity, than for his talents and genius. For those were the days of trial, and there were few individuals to whom with safety the great interests of the country abroad could be trusted.

Although his last days were in some measure rewarded, his early history presents a picture of the destitution, which is more commonly the hard lot of such men as have employed their powers for the public welfare, and wasted their strength in the service of their country, and absolutely need substantial proof of the gratitude of the republic to keep them from poverty.

4. Next take the case of Robert Fulton, the great steam engineer. He was born in Pennsylvania, 1765. His peculiar genius manifested itself at an early age. In childhood his hours of recreation were passed in the shops of mechanics, or in the employment of his pencil, true indications of a philosophic mind. At the age of twenty he embarked for England, where he studied with our distinguished countryman Benjamin West, and became a painter. In the year 1793 we find Mr Fulton actively engaged in a project to improve inland navigation, and he obtained various patents for different kinds of inventions, from the British government. Among the rest, was one for scooping out the earth to form channels for canals and aqueducts; for the subject of inland navigation seems now to have employed his attention. In 1797 he went to Paris and studied the higher mathematics, physics, chemistry and perspective. After employing himself in various inventions he returned to America in 1806. From this period may be dated the application in this country of steam to propelling boats. In 1801, he gave to Messrs Watt & Bolton instructions for constructing the first steam engine, which was successfully used in propelling boats. Yet he made no pretensions as an inventor with respect to the engine. Though small boats had been constructed to move with steam, yet no one had been made practically useful in Europe or America till Mr Fulton bent the ardor of his inventive mind to this business. In the year 1806 a boat was made and the next year moved majestically up the Hudson River, and the enterprising inventor obtained two patents for his improvements. Since that period, though but a few years have elapsed, what astonishing progress has been made in the means of communication between distant but important sections of the country?

Every considerable river is navigated by steam-boats, and they are the source of wealth and prosperity to this country almost incalculable in greatness and extent.

I might here mention the agency of Fulton in the stupendous project the Erie Canal; and tell of his new plans and experiments relative to submarine warfare, and of the construction of the Steam Frigate, which bore his name. These indications of skill and perseverance are fresh in the memory of the middle aged, and by showing what has been done in the department of mechanics may stimulate to effort and perseverance those who have already made some proficiency in practical science. Mr Fulton owed more to experience and reflection than to books, and his sentiments are interesting from their originality. In all his domestic and social relations he was zealous, kind, generous, liberal and affectionate. He knew of no use for money, but as it was subservient to charity, hospitality and the sciences. His constancy and industry were remarkable. His wonderful patience and untiring perseverance enabled him to overcome almost all difficulties. If frustrated in one project, he did not yield to melancholy; but applied his vigorous intellect to another and was not satisfied till he saw decisive indications of success.

Now what was the reward Mr Fulton received for his eminent services in the cause of humanity? For if property is valuable to any end, it is to improve the condition of mankind and make the path of life pleasant. What gratitude and gifts were bestowed upon this wonderful American genius for his profound researches, and supreme devotion to a cause which has enriched his country and furnished thousands of her citizens with the means of subsistence? — the man whose inventions have furnished bread to a host of mechanics in all the branches of their business, from the smelting of the iron to the final completion of the complicated engine.

He was for a long time engaged in expensive lawsuits, vexatious and ruinous controversies with those who interfered with his patent rights and exclusive grants. Whatever funds he may have gathered by his laborious oc-

cupations were wasted in defence of his pretensions as an inventor and in rescuing from the monopoly of others, what he considered rightfully belonging to him. We pretend not to sit in judgment on questions of law, which have received the decisions of some of the highest tribunals of justice in our land — but this is certain, — the evening of his days were clouded with inextricable embarrassments, and his death left his children pennyless in the world.

Within a few years a proposition was circulated through the public journals to have a small tax of one cent collected of each individual passenger in a steamboat, for the benefit of his family, to keep alive the remembrance of Fulton and relieve his children from want. We have never heard that this small pittance has been given them; so soon do the benefactors of men pass out of the remembrance of the public.

Were it becoming to speak here of the merits of the living, we might introduce many cases of those who have been distinguished for skill and enterprise, who deserved well of their country and of whom it might be proud, but whose inventions met with a cold reception, or scanty reward from those who should have been the patrons of the arts. Memory reverts to one who has long puzzled the counterfeiters of our currency, to the joy of honest men, by the introduction, or rather improvement of steel plate printing, now extensively used by banking corporations. The same man has improved the air gun, and prosecuted his inquiries into the principles of steam enginery, and mechanics, far beyond the patronage he might hope for in this country, and who long since left it for other regions, where he may hope for greater or surer rewards for his enterprise and skill.

5. The life of De Witt Clinton is an illustration of the remark that some of the principal benefactors of mankind has received but a small recompense for the best inventions. Mr Clinton was an American by birth, but of English or Dutch origin. He was one of the ablest and best men New York has ever seen. A devoted student, of a powerful mind, and one who gave his whole strength to every pursuit which demanded his energies.

He was honored by his fellow-citizens and elevated by his native State to various high and important stations, and in every difficulty of a state concern Mr Clinton was looked upon to unravel it. When the two great political parties of this country were organized in 1797, Mr Clinton embraced what is now the popular party, and received since that period the highest honors of the State, for a series of years. But he was too near the pinnacle of fame to remain there long. The voice of popular clamor, the voice of ignorance and debased moral sentiment said, he must come down. He had done so much for the State by his zeal for internal improvements, he had labored so hard for the honor and good of that great Commonwealth, that he must make way for others, and receive the recompense — dishonor and a withdrawal of public confidence and pecuniary support, the last of which seemed necessary for the subsistence of himself and numerous family. Accordingly in the year 1820, a strong and violent opposition was set up against him.

The canal project, which is now the glory of the State, and which Mr Clinton, though not the originator, promoted by his eloquence and perfected by his power, did not protect him from malice and slander, nor shield him from the poisoned arrows of defamation. The various public presses of the popular faction poured forth a torrent of abuse against him; and he was for a season deprived of all power connected with that benevolent enterprise. And this too without any plausible reason whatever.

Mr Clinton was an early riser and extremely laborious. Every moment which he could spare from his necessary duties was devoted to the cultivation of his mind and to the public good. He was well versed in physical sciences, and a member of numerous distinguished societies in this country and in Europe. His literary and scientific discourses are many. He was the friend of his country, the patron of science, the lover of peace, and in war the avenger of his country's wrongs.

In the various offices of a public nature which he held, he was faithful to his trust, and is justly entitled to durable renown. His national services too were of the greatest importance. His learning and ability as a magis-

trate, an orator, and judge of the highest tribunal in New York, were great, and received unqualified encomium. He was a man of fine, dignified, vigilant and indomitable integrity.

Such a man should be long had in grateful remembrance by the people, and we might suppose hardly any rewards were too great to be bestowed on him. But what was the fact in his case, what return did he get for his arduous services. It is said of him, that he never derived a pecuniary benefit from any office which he held, though he had often opportunities for acquiring great affluence.

4. The last instance illustrative of the position advanced in this tract now to be mentioned, is the case of Eli Whitney, a native of Worcester county, Massachusetts, the ingenious inventor of the "cotton gin." Here it should be premised, that almost the whole of the machinery employed in the manufacture of cotton has been invented within the last fifty years. When the machinery was introduced the price of cotton fabrics was reduced, the demand for consumption increased, and the supply was extended to meet the demand. Some who had been accustomed to spin and weave at home lost their work, but a greater number found employment in the factories. Among other improvements the power loom was introduced; requiring only the superintendence of a single individual, it performed the labors of numbers. The shuttle dropped from the fingers of the weaver and fell into iron fingers, that could ply it faster.

This business aided by new inventions went on with unabated increasing activity. The disproportion between the cost of production and the price of the manufactured article saves immense profits. Millions were added to the millions already invested in these establishments. But the chief source of increase in this production was the discovery of a new method by which to clean the raw material, for before the discovery of the saw gin, it was scarcely an object for the planter to raise cotton. The separation of the seed from the cotton had always presented the greatest obstacle to its successful cultivation; but since Mr Whitney's invention, the increase of cotton for exportation and home consumption

is truly astonishing. The saw gin consists of a receiver having one side covered with strong parallel wires about an eighth of an inch apart. Between these wires pass a number of circular saws revolving on a common axis. The cotton is entangled in the teeth of the saws and drawn out through the grating while the seeds are prevented by their size from passing.

The cotton thus extricated is swept from the saws by a revolving cylindrical brush, and the seeds fall out at the bottom of a receiver. The great value of this invention to the planters of the South was immediately seen and proved, and the author secured the patent right. These machines were set up and used without any respect to his right of invention, which occasioned the prosecution of many individuals for their infringement of his privilege, and Mr Whitney was perplexed with long and tedious and expensive lawsuits in vindication of his claim as patentee, and in endeavoring to arrest the construction of his gin without his permission. The people were so impressed with its value, that they determined upon its immediate and general use without securing to the inventor his patent right, given him by the highest authority in the country. Self-interest was stronger than the arm of justice, and in vain were his efforts to keep the right of invention within his reach.

After the use of this instrument, the increase of the production of cotton is more wonderful than the manufacture. In the year 1791, the whole export of cotton from the United States was sixtyfour bales of three hundred pounds each, or 19,200, pounds. The average exportation of the years 1826, 27, and 28, is 235,000,000, of pounds. Here at one glance is seen how great and valuable was this invention of Mr Whitney. What wealth has rolled in upon the southern planters by reason of the exertion of his mind and the production of his skill?

It might be supposed that a considerable portion of the profits of their staple production would readily be imparted to the man, who placed in their hands the means of opulence. He should have been hailed as the intelligent benefactor of the South by the men, who could

bear testimony to his worth, in the multiplication of their comforts through his instrumentality. But how stands the truth in the case? So active and persevering was he to secure his right and enjoy some pecuniary advantage from his own machine, that the popular indignation was roused against him, and an attempt was made to have him indicted by a grand jury as a common nuisance and disturber of the peace, and to throw him into prison. There was a determination to deprive him of all the benefits of his application and improvement. After years of severe toil, anxiety and vast expenditure, there was a turning of public opinion in his favor and a considerable remuneration was voted him by one or more States. What advantage was this boon, purchased at so dear a rate? It was comparatively not a tithe of his dues, when granted, considering the care and labor and funds spent in its acquisition. Such is the reward of industry and invention in a multitude of cases. No man should frame large plans of public patronage, but be contented if the laws of the country, and her justice, secure to him his natural or acquired rights. Mr Whitney considered himself entitled to the first benefit of his own invention, but the cold selfishness of man refused to give it him. And thus it has been in a thousand cases before.

After individuals have served communities without reward, they scarcely receive the thanks of those who are benefited by their labors, when those very communities consider their benefactors under obligation to serve them still longer or not, just as the inclination or caprice of the people happens to direct. And what relief is to be found in this state of public feeling? It is only in the hope that wisdom and learning will eventually take the place of folly and ignorance, when the honor and other rewards of industry and skill will be commensurate with the progress of the human intellect, and the devotion of man to the public good.

The remedy for public ingratitude is enlightened political freedom; it is to elevate the standard of honesty and integrity of principle. For the present generation to exert its influence in diffusing correct information and

to raise the tone of public morals — to open to the people sources of knowledge, and carry to every man's door the means of wholesome instruction, and to discountenance all unjustifiable motives to action. These days of freedom, moral and mental, are to be hastened by the means of improvement eminently characteristic of the present age. When correct principles of thought, and action have the ascendency in our communities, true merit will not fail of permanent reward.

The lovers of science, the promoters of inventions, the skilful mechanic, the practical philosopher and the advocates of a pure morality, will each exert a reciprocal influence, and form but one great community laboring in their several spheres of duty, to see who shall deserve most of their country and receive for his industry and skill the substantial rewards of a free people.

The conclusions to which we have arrived and which we think grow out of the preceding remarks are,

1. No person should deprecate or condemn in broad or positive assertions the utility of inventions or improvements, because they are beyond his limited capacity, or the immediate value of which is not realized in the increase of his own estate. 'Inventions of little splendor and which could not be appreciated by mankind generally, such as the spinning apparatus of Arkwright and the application of the steam power by Watt, opened to Great Britain sources of wealth in her various manufactures, and supplies furnished to other countries, and thus enabled her to support those vast armies which secured the liberty of Europe and stopped the progress of Napoleon, in his endeavors for universal dominion. "These inventors were more worthy of lasting honors than the proudest conqueror, in his greatest desolations of the earth." Their names have not been blazoned in song, though the historian honors them with a cursory notice, yet did these men by their astonishing genius, confer on England power to control the issue of the most fearful and momentous struggle that ever put in peril the best interests of men.'

2. Improvements in any of the mechanic arts which augment the power of production, and essentially diminish labor, benefit the whole community. It is therefore unphilosophical and improper to say, that the prosperity of manufactures advances one part of the nation to the injury of the other. The manufacturer furnishes a ready market for the surplus produce of the farmer, and purchases the raw material of the grower to be converted into fabrics for the merchant. In this way the various occupations of our citizens are encouraged, and industry and thrift furnish the means of life and enjoyment.

3. It is the duty of all men to patronize industry and skill so far as practicable, and whatever money is appropriated to this end, though it may never come back to its owner with usury, goes to advance the great interests of society, and augments the happiness of this world. It is like purchasing stock, the benefit of which other generations will realize and venerate the memory of those who secured to them such valuable possessions.

4. Some of the greatest blessings we now enjoy, were purchased by the hardships, and sufferings, and poverty, and at the expense of the life of the greatest men the world can boast. Their memory should be precious, and the recollection of their deeds should rouse to vigorous exertions and perseverance, those whom providence has elevated by strong native powers of intellect, and if immediate success does not crown their labors, unwearied application will educe light from darkness, and bring to pass most important and surprising results. Let no one therefore shrink back from following lawful pursuits, however small the beginning of his labor, provided they serve to develope genius, because there is no bright prospect of present reward. Other and distant generations will remember him with gratitude and recount his industry with lawful emulation; thus his life will be useful and his deeds live after him in all the efficiency of a vivid example, to stimulate others to perseverance and enterprise.

5. Let it be remembered that most of the great men that have existed were good men. They who have pro-

duced the most valuable treatises and were the greatest discoverers and wisest philosophers were decidedly virtuous men. It is a mistaken idea that genius exists only in the head of the skeptic or the wine-bibber, or the irreligious devotee of sensuality and vice. If a few persons of eminence have had debased moral character, it is not true of most of them. I am aware that some poets and philosophers of wretched morals have existed, the influence of whose productions is contaminating in the highest degree: but their works were short-lived and of limitéd extent, and the best treatises handed down to ùs on scientific subjects are from the pens of practical believers in religion. Newton, Locke, Boyle, Addison, and Brown, were eminently christian in their character, and even of Dr Franklin it may be said, the excesses of the morning of his life were subjects of regret in the evening of his days, and his advice to young men is to cherish a high regard for Christianity, and we may hope he died a virtuous man.

Even the great men of remote antiquity who lived before Christ, and some who lived since, in the regions of darkness and error, were true to their worship and punctually performed the rites and ceremonies of the mother church. The religious are not all philosophers, or distinguished for skill, yet all true science and philosophy has its foundation in christian truth; and they have gone hand in hand. Place your finger on the map of the world and trace those regions where the arts, sciences and *true philosophy* have flourished best, and you will find those are the places where Christianity has shed its benignant influences.

6. While genius ordinarily fails of great rewards, it is no less the duty of men to cultivate and improve it. For while its developments enrich the world, they furnish a rich pleasure in a knowledge of the extraordinary powers with which the human mind is endowed. No man, till he has studied philosophy in some form, or diligently reflected upon the operations of his own mind, can have a just idea of the great things, for which Providence has fitted his understanding. It is interesting to become acquainted with the genius of such as have ex-

alted the nature of man above its destined sphere and so become admitted to fellowship with the great teachers of the world. Labor is the life of man. This is according to his original constitution and the laws of his life. It is honorable to be active, and while the industrious should avoid the temptations of their calling, it is a laudable ambition which prompts them to pry into the principles of their occupation, and to study the nature of their employment. In this way, according to his talents, each may become an improver of the art he works in, and a discoverer of the sciences connected with his labor. There are various gratifications which are the reward of industry. But the highest gratification in the contemplations of science is, that man is raised to an understanding of the perfections and goodness of the Creator as displayed in his works. We advance not a single step without perceiving extraordinary traces of design and skill, and the impression is irresistible, that the whole scheme of Divine Providence is in perfect harmony with the plans of infinite benevolence.

The *pleasures* of science go hand in hand with the solid benefits derived from it. They make life more agreeable and valuable.

It becomes every rational being to direct his mind to pursuits which lie in the sure path to virtue and happiness. And whether individual exertions in the cause of improvement be crowned with present reward or not, whether they receive the commendation of living men, or not, these exertions are sustained by an approving conscience, and if the motives be pure have the approbation of God.

IRON MINE IN SWEDEN.

The following interesting description of the interior of an iron mine, is from the pen of a traveller who visited it.

For grandeur of effect, filling the mind of the spectator with a degree of wonder, which amounts to awe, there is no place where human labor is exhibited under

circumstances more tremendously striking. As we draw near to the wide and open abyss, a vast and sudden prospect of yawning caverns and prodigious machinery prepared us for the descent. We approached the edge of the dreadful gulf, whence the ore is raised, and ventured to look down; standing on the verge of a sort of platform, constructed over it in such a manner as to command a view into the great opening, as far as the eye could penetrate amidst its gloomy depths; for, to the sight, it is bottomless. Immense buckets, suspended by rattling chains, were passing up and down; and we could perceive ladders scaling all the inward precipices on which the work people, reduced by their distance to pigmies in size, were ascending and descending. Far below the utmost of these figures a deep and gaping gulf, the mouth of the lower-most pits, was by its darkness rendered impervious to the view. From the spot where we stood down to the place where the buckets are filled, the distance might be about seventyfive fathoms; and, as soon as any of these buckets emerged from the gloomy cavity we have mentioned, or until they entered into it, in their descent they were visible; but, below this point they were hid in darkness. The clanking of the chains, the groaning of the pumps, the hallooing of the miners, the creaking of the blocks and wheels, the trampling of horses, the beating of the hammers, and the loud and frequent subterraneous thunder from the blasting of the rocks by gunpowder, in the midst of all this scene of excavation and uproar, produced an effect which no stranger can behold unmoved. We descended with two of the miners and our interpreter into this abyss. The ladders, instead of being placed like those in our Cornish mines, on a series of platforms as so many landing places, are lashed together in one unbroken line, extending many fathoms; and, being warped to suit the inclination or curvature of the sides of the precipices, they are not always perpendicular, but hang over in such a manner, that, even if a person held fast by his hands, and if his feet should happen to slip, they would fly off from the rock, and leave him suspended over the gulf. Yet such ladders are the only means of access to the works below; and, as the laborers are not accustomed to receive stran-

gers, they neither use the precautions, nor offer the assistance usually afforded in more frequented mines. In the principal tin-mines of Cornwall, the staves of the ladders are alternately bars of wood and iron; here they were of wood only, and in some parts rotten and broken, making us often wish, during our descent, that we had never undertaken an exploit so hazardous. In addition to the danger to be apprehended from the damaged state of the ladders, the staves were covered with ice or mud; and thus rendered so cold and slippery, that we could have no dependence on our benumbed fingers if our feet failed us. Then to complete our apprehension, as we mentioned this to the miners, they said, "Have a care, it was just so talking about the staves, that one of our women fell about four years ago as she was descending to her work." "Fell!" said our Swedish interpreter rather simply, "and, pray, what became of her?" "*Became of her!*" continued the foremost of our guides, disengaging one of his hands from the ladder, and slapping it forcibly against his thigh, as if to illustrate the manner of the catastrophe — "*she became a pancake.*"

As we descended further from the surface, large masses of ice appeared covering the sides of precipices. Ice is raised in the buckets with the ore and rubble of the mine. It has also accumulated in such quantity in some of the lower chambers, that there are places where it is fifteen fathoms thick, and no change of temperature above prevents its increase. This seems to militate against a notion, now becoming prevalent, that the temperature of the air in mines increases directly as the depth from the surface, owing to the increasing temperature of the earth under the same circumstances, and in the same ratio. But it is explained by the width of the aperture at the mouth of this mine, which admits a free passage of atmospheric air. In our Cornish mines, ice would not be preserved in a solid state at any considerable depth from the surface.

After much fatigue, and no small share of apprehension, we at length reached the bottom of the mine. Here we had no sooner arrived, than our conductors, taking each of us by an arm, hurried us along through regions

of "thick ribbed ice," and darkness, into a vaulted level, through which we were to pass into the principal chamber of the mine. The noise of countless hammers, all in vehement action, increased as we crept along this level; until at length, subduing every other sound, we could no longer hear each other speak, notwithstanding our utmost efforts. At this moment we were ushered into a prodigious cavern, whence the sounds proceeded; and here, amidst falling waters, tumbling rocks, steam, ice, and gun-powder, about fifty miners were in the very height of their employment. The magnitude of the cavern, over all parts of which their labors were going on, was alone sufficient to prove that the iron ore is not deposited in veins, but in beds. Above, below, on every side, and in every nook of this fearful dungeon, glimmering tapers disclosed the grim and anxious countenances of the miners. They were now driving bolts of iron into the rocks, to bore cavities for the gunpowder for blasting. Scarcely had we recovered from the stupefaction occasioned by our first introduction into this *Pandæmonium*, when we beheld close to us hags more horrible than perhaps it is possible for any other female figures to exhibit, holding their dim, quivering tapers to our faces, and bellowing in our ears. One of the same sisterhood, snatching a lighted splinter of deal, darted to the spot where we stood, with eyes inflamed and distilling rheum, her hair clotted with mud, and such a face, and such hideous yells, as it is impossible to describe. If we could have heard what she said, we should not have comprehended a syllable; but as several others, equally *Gorgonian* in their aspect, passed swiftly by us, hastening tumultuously towards the entrance, we began to perceive, that if we remained longer in our present situation, *Atropos* might cut short the threads of our existence: for the noise of the hammers had now ceased, and a tremendous blast was near the point of its explosion. We had scarcely retraced with all speed our steps along the level, and were beginning to ascend the ladders, than the full volume of the thunder reached us, and seemed to shake the earth itself with its terrible vibrations. — *Dr Clarke's Travels.*

SCIENTIFIC TRACTS.

VOL. II......NO. XVIII.

EVIDENCES OF CHRISTIANITY.*

We do not intend in this series of tracts, to enter at all into the discussion of religious or theological subjects, except such as come, on account of the literary interest which they excite, within the boundaries of the great field of *general literature*. The historical evidences of Christianity constitute a topic of this class.

The first inquiry which meets us in entering upon the consideration of this subject, is, — "What sort of evidence are we to expect?" The only proper answer is, that sort of evidence which men require to produce conviction and to control the conduct in other cases. The human mind is so constituted that men are governed by a certain kind and degree of evidence in all the concerns of life, — a kind and a degree which is adapted to the circumstances in which we are placed here. This evidence, however, almost always falls *very far* short of *demonstration*, or *absolute certainty*. Still it is enough to control the conduct. By the influence of it a man will embark in the most momentous enterprises, and he is often induced by it to abandon his most favorite plans.

Still it is very far short of demonstration or absolute certainty. For example, a merchant receives in his counting room a newspaper, which marks the prices of some species of goods, at a foreign port, as very high. He immediately determines to purchase a quantity and

* Furnished by the author of the Young Christian; the substance of this article being contained in that work.

to send a cargo there. But suppose, as he is making arrangements for this purpose, his clerk should say to him, "Perhaps this information may not be correct. The correspondent of the editor may have made a false statement for some fraudulent purpose, or the communication may have been forged; or some evil minded person having the article in question for sale may have contrived by stealth to alter the types, so as to cause the paper to make a false report, at least in some of the copies."

Now in such a case would the merchant be influenced in the slightest degree by such a sceptical spirit as this? Would he attempt to reply to these suppositions, and to show that the channel of communication between the distant port and his own counting room, *could not have been* broken in upon by fraud, somewhere in its course, so as to bring a false statement to him? He could not show this. His only reply must be, if he should reply at all, "The evidence of this printed sheet is not perfect demonstration, but it is just such evidence in kind and degree, as I act upon in all my business. And it is enough. Were I to pause, with the spirit of your present objections, and refuse to act whenever such doubts as those you have presented might be entertained, I might close my business at once, and spend life in inaction. I could not, in one case in ten thousand, get the evidence which would satisfy such a spirit."

Again. The reader is a parent I suppose. You have a son travelling at a distance from home, and you receive some day a letter from the Post Office, in a strange hand writing, and signed by a name you have never heard, informing you that your son has been taken sick, at one of the villages on his route, and that he is lying dangerously ill at the house of the writer, and that he has requested that his father might be informed of his condition, and urged to come and see him before he dies.

Where now is the father, who, in such a case would say, to himself, "Stop, this may be a deception. Some one may have forged this letter to impose upon me. Or there may be no such person. Before I take this journey, I must write to some responsible man in that village, to ascertain the facts."

No; instead of looking with suspicion upon the letter, scrutinizing it carefully to find marks of counterfeiting, he would not even read it a second time. As soon as he had caught a glimpse of its contents, he would throw it hastily aside, and urging the arrangements for his departure to the utmost, he would hasten away, saying, "Let me go, as soon as possible, to my dying son."

We will state one more case, though perhaps it is so evident upon a moment's reflection, that men do not wait for perfect certainty in the evidence upon which they act, — that we have already stated too many.

Your child is sick, and as he lies tossing in a burning fever on his bed, the physician comes in to visit him. He looks for a few minutes at the patient, — examines the symptoms, — and then hastily writes an almost illegible prescription, whose irregular and abbreviated characters are entirely unintelligible to all but professional eyes. You give this prescription to a messenger, — perhaps to some one whom you do not know, — and he carries it to the apothecary, who from the indiscriminate multitude of jars and drawers and boxes, filled with every powerful medicine and corroding acid, and deadly poison, selects a little here and a little there, with which, talking perhaps all the time to those around him, he compounds a remedy for your son. The messenger brings it to the sick chamber, and as he puts it into your hands, do you think of stopping to consider the possibility of a mistake? How easy might the physician by substituting one barbarous Latin name for another, or by making one little character too few or too many, so alter the ingredients, or the proportions of the mixture, as to convert that, which was intended to be a remedy, to an active and fatal poison. How easily might the apothecary, by using the wrong weight, or mistaking one white powder for another precisely similar in appearance, or by giving your messenger the parcel intended for another customer, send you, not a remedy which would allay the fever and bring repose to the restless child, — but an irritating stimulus, which should urge on to double fury the raging of the fever, or terminate it at once by sudden death.

How possible are these; but who stops to consider

them? How absurd would it be to consider them! You administer the remedy with unhesitating confidence, and in a few days the returning health of your child, shows that it is wise for you to act, even in cases of life and death, on *reasonable evidence*, without waiting for the absolute certainty of moral demonstration.

Now this is exactly the case with the subject of the Christian religion. It comes purporting to be a message from heaven, and it brings with it just such a kind of evidence, as men act upon in all their other concerns. The evidence is abundantly satisfactory; at the same time however, any one who dislikes the truths, or the requirements of this gospel, may easily, like the sceptical clerk in the case before mentioned, make objections and difficulties in abundance. A man may be an infidel if he pleases. There is no such irresistible weight of argument that the mind is absolutely forced to admit it, as it is to believe that two and three make five. In regard to this latter truth, such is the nature of the human mind that there is not, and there cannot be in the whole human family, an individual who can doubt it. In regard to Christianity, however, as with all other truths of a moral nature which regulate the moral conduct of mankind, there is no such irresistible evidence. The light is clear, if a man *is willing to see*, but it is not so vividly intense, as to force itself through his eyelids, if he closes them upon it. Any one may walk in darkness if he will.

The evidences of Christianity are usually considered as of two kinds, *historical* and *internal*. There may properly be added a third which I shall call *experimental*. These three kinds are entirely distinct in their nature.

1. If we look back upon the past history of Christianity, we find that it was introduced into the world under very remarkable circumstances. Miracles were performed, and future events foretold, in attestation of its divine origin, and the founder was restored to life after being crucified by his enemies. These, with the various circumstances connected with them, constitute the *historical* evidence of Christianity.

2. If now we examine the book itself; — its truths, its doctrines, its spirit, — we find that it is exactly such, in

its nature and tendency, as we should expect a message from Jehovah to such beings as we, would be. This is the *internal* evidence.

3. Now if we look upon the *effects which the Bible produces*, all around us, upon the guilt and misery of society, wherever it is faithfully and properly applied, we find it efficient for the purposes for which it was sent. It comes to cure the diseases of sin,—and it *does cure* them. It is intended to lead men to abandon vice and crime, and to bring them to God, and it does bring them by hundreds and thousands. If we make the experiment with it, we find that it succeeds, in accomplishing its objects. This we may call the *experimental* evidence.

These three kinds of evidence are so entirely distinct in their nature, that they apply to other subjects. You have a substance which you suppose is phosphorus. For what reason? Why, in the first place, a boy, in whom you place confidence, brought it for you, from the chemist's, and he said it was phosphorus. This is the *historical* evidence. It relates to the history of the article before it came into your possession. In the second place, you *examine* it, and it looks like phosphorus. Its color, consistence and form all agree. This is *internal* evidence. It results from internal examination. In the third place, you *try* it. It burns with a most bright and vivid flame. This last may be called *experimental* evidence; and it ought to be noticed, that this last is the best of the three. No matter what grounds of doubt and hesitation there may be in regard to the first and second kinds of evidence, if the article simply proves its properties on trial. If any one should say to you, "I have some reason to suspect that your messenger was not honest, he may have brought something else; or this does not look exactly like real phosphorus; it is too dark or too hard." Your reply would be, "Sir, there can be no possible doubt about it,—Just see how it burns!"

Just so with the evidences of Christianity. It is interesting to look into the historical evidences that it is a revelation from heaven, and to contemplate also the internal indications of its origin, but after all, the great evidence on which it is best for Christians, especially

young Christians, to rely for the divine authority of the Bible, is its present universal and irresistible power in changing character, and saving from suffering and sin. We shall, however, in the present tract consider only the former of these arguments, that one being alone suitable to the character and design of this series.

If the Creator should intend to send a communication of his will to his creatures, we might have supposed that he would, at the time of his making it, accompany the revelation with something or other, which should be a proof that it really came from him. Monarchs have always had some way of authenticating their communications with their subjects or with distant officers. This is the origin of the use of seals. The monarch at home possesses a seal of a peculiar character. When he sends any communication to a distance, he impresses this seal upon the wax connected with the parchment upon which the letter is written. This gives it authority. No one else possessing such a seal, it is plain that no one can give the impression of it, and a seal of this kind is very difficult to be counterfeited. Various other devices have been resorted to by persons in authority, to authenticate their communications.

In the same manner we must have expected that Jehovah, when he sends a message to men, will have some way of convincing us that it really comes from him. There are so many bad men in the world who are willing to deceive mankind, that we could not possibly tell, when a pretended revelation comes to us, whether it was really a revelation from heaven, or a design of wicked men, unless God should set some marks upon it, or accompany it with some indications which bad men could not imitate.

The Bible professes to have been accompanied by such marks. They are, the power of working miracles and foretelling future events, possessed by those who brought the various messages it contains. It is plain that men, without divine assistance, could have had no such power. If this power then really accompanied those who were the instruments of introducing the Christian religion into the world, we may safely conclude that it was given them by God, and as he would never give this power to sanction imposture, the message brought must be from him.

The way then to ascertain whether these miracles were actually performed is like that of ascertaining all other matters of fact, by calling upon those who witnessed them for their testimony.

The manner in which these witnesses are to be examined, is similar to that pursued in ordinary courts of justice. It is similar, we mean, in its principles, not in its forms. We know of nothing which shows more convincingly the satisfactory nature of this evidence, than a comparison of it with that usually relied on in courts of justice. In order to exhibit the former, then, distinctly, we shall briefly exhibit the principles which are considered essential in the establishment of facts by testimony, before a jury.

There are three points which it is considered absolutely necessary to secure.

1. That the witnesses should be *of good character*. 2. That they should have actually *witnessed* what they describe. And 3. That the precise account which they themselves give, should come into court. These points, the judge or the lawyers secure. The latter they obtain, by having the witness himself always come, if it is possible, even if he has to leave most important business for this purpose. If, from sickness, or any other similar cause, he cannot come, his testimony is taken down in writing, and signed by himself, and that paper, the very one which he signed, must be brought into court, and read there. This is called a deposition. The second point is secured by not allowing any man to go any farther in his testimony than he himself saw or heard. So that, sometimes, when the case is complicated, a very large number of witnesses are called before the whole case is presented to the jury. The first they secure, by inquiring into the character of the witnesses. If any man can be proved to be unworthy of credit, his testimony is set aside.

Now all these points must be looked at in examining the evidence of the Christian miracles.

1. We must ascertain that we have the exact account given by the witnesses themselves.

2. We must ascertain that they had distinct opportunities to witness what they describe.

3. We must have evidence that they are credible. That is, that they are honest men, and that their word can be relied upon.

These three points we shall examine in order, in reference to the Christian miracles. The witnesses are the four evangelists, Matthew, Mark, Luke, John, and the first inquiry, according to the list above presented, is to determine whether we have exactly the account which they themselves give. Witnesses are commonly called into court, to tell their own story there, and then there can be no mistake. If that is impossible, as I remarked above, their deposition is taken with certain forms, and the very paper they originally signed, is brought and read in court. But neither of these courses can be taken here. For in the first place, the witnesses have been for a long time dead, so that they cannot come forward to give their testimony ; and, though they did write a full account at the time, yet it was so many years ago, that no writing could remain to the present period. Time has entirely destroyed all vestiges of the writings of those days.

We presume all our readers are aware, that not long after the time of our Saviour, the barbarians from the North, in innumerable hordes, began to pour down upon the Roman empire, until at last they subverted and destroyed it. Very many of those barbarians became nominal Christians, and preserved some copies of the Bible, and, in fact, they saved many extensive and valuable libraries of manuscripts, in rolls, (the art of printing not being then known,) but they destroyed most of the institutions and the accumulated property of civilized life, and brought a long period of ignorance and semi-barbarism, called the dark ages, upon the world. After some time, however, there began to be, in various parts of Europe, a gradual improvement. The monks in the various convents, having no other employment, began to explore the old libraries and to study the books. They made themselves acquainted with the languages in which they were written, and when the art of printing was invented, they published them. In consequence, however, of the immense numbers of manuscripts collected in some of

the libraries, a long time elapsed before they were fully explored, and even now, the work is not absolutely completed. New writings are occasionally brought to light, and published. The work of deciphering such old, worn out, faded, and almost illegible parchment rolls is very great.

A great deal of interest was felt, at the very first, by these explorers, to find the oldest copies of the Bible, or of any parts of the Bible. They wished to have the most accurate and authentic copy possible, and the more ancient the copy, the more probable it was that it was taken directly from the original, and consequently the more it was to be depended upon. If they could have found a manuscript, which was evidently the very copy originally written by the author himself, it would have been considered invaluable.

The number of manuscripts of the whole, or of parts of the Hebrew Bible, thus found, and now preserved in various libraries of Europe, is more than four hundred, and of the Greek Testament, not far from one hundred and fifty. They are scattered all over Europe, and are preserved in the libraries with great care. The oldest of them, however, was written several hundred years after the death of Christ, so that we now cannot ever have the actual account written by the original witnesses. The two methods usually relied on, therefore, in courts of justice, for being sure that the actual story of the witness himself is presented in court, fail in this case. We must resort, therefore, to another method, equally certain, but a little different in form.

The evidence relied upon to prove that the books we have now, or rather the ancient manuscripts in the libraries in Europe from which they are translated, are really the same with the accounts originally written by the witnesses themselves, is this. Immediately after they were written, a great many other Christian writers, very much interested in these accounts, began to quote them in their own letters and books. They quoted them much more copiously than it is customary to quote now, because the art of printing puts every important book within the reach of all who are interested in it. Then, the original

accounts were only in manuscript, and, consequently, could be seen and read only by a few. These few, therefore, in their writings, made frequent and copious extracts from them; and these extracts have come down to us separately, and each one proves that the passage it contains, which is in the account now, was in that account when the quotation was made.

An imaginary instance will make this plain. The Vatican manuscript, as it is called, that is, a very ancient manuscript, preserved in the library of the Vatican at Rome, is supposed to have been written about four hundred years after Christ. It contains, we will suppose, John's Gospel, just as we have it now, in our Bibles. This proves, that if the *real, original account*, which John gave, was altered at all, after he wrote it, it was altered before that time. Now suppose a Christian at Antioch, living *two hundred years before the Vatican manuscript was written*, had been writing a book, and in it had mentioned John's Gospel, and had copied out a whole chapter. This book he leaves at Antioch. It is copied there again and again, and some copies are found there at the revival of learning, after the dark ages. Here we have one chapter proved to have been in John's account, *two hundred years earlier* than the date of the Vatican manuscript. In the same manner, another chapter might have been quoted in another book, kept at Alexandria, — another at Rome, &c. And the fact is, that these quotations have been so numerous, that they have formed an uninterrupted succession of evidences, beginning but a very short time after the original accounts were written, and coming down to modern times. Every chapter and verse is not, indeed, confirmed in this way, but everything in the least degree important is. All the material facts, and every particular in regard to which there could be any necessity for this evidence, are furnished with it. Learned men have taken a great deal of pains to explore and collect this mass of evidence in favor of the genuineness of the sacred books. These quotations have been most carefully examined and republished, so that all who are inclined to go into an examination of them can do so. Dr Paley, in his Eviden-

ces of Christianity, has presented enough to satisfy any mind of sufficient attainments to appreciate such an argument.

We say of sufficient attainment, for it requires not a little. There are very few, excepting professed scholars, who can have time to go fully enough into an examination of this subject to form an independent judgment. We have not attempted in the above remarks to present you with the argument itself, but only to explain the nature of it. As we remarked before, we do not think the historical argument is calculated to come with so much force to the minds of Christians generally, as the evidences of another kind. All ought, however, to understand its nature.

We may consider, then, the fact, that these almost innumerable quotations from the writers of the New Testament, and translations from them, forming a series which commenced soon after the writings first appeared, and continuing, in uninterrupted succession, down to the present time, as abundant evidence that *the story we now have*, is the *story originally given* by the witnesses themselves. This evidence does satisfy all who fully examine it. And this is the first point in the investigation.

But the question will arise in the minds of many of our readers, Why is it necessary to prove so fully and formally such a point as this? Why is it necessary to show so carefully that these are precisely, in all important respects, the very accounts originally written by the witnesses themselves? The answer is this. Unless this point were very carefully and fully proved, we might have supposed that the prevailing belief of the truth of the Christian miracles, and the general circulation of our present books, might have arisen in this way. Suppose, that eighteen hundred years ago, a good man, named Jesus Christ, had been dissatisfied with the prevailing errors and superstitions, and had taught a purer system of religious and moral duty. His followers become strongly attached to him. They repeat to one another his instructions, follow him from place to place, and soon attract the attention of the authorities of the country. Like Socrates, he is persecuted by his enemies, and put

to death. After his death, his disciples make greater and greater efforts to promote his principles. They relate, with some exaggeration, the incidents of his life. His benevolence and kindness to the sick and to the afflicted is gradually, as the stories are repeated again and again, magnified to the exertion of miraculous power. One extraordinary narrative after another gradually gains credit and circulation. No one intends to deceive, but, according to the universal tendency in such cases, even where stories that strongly interest the feelings are circulated among good men, the accounts gradually and insensibly assume a marvellous and miraculous air, and, after a time, when years have elapsed, and no method of ascertaining the truth remains, these exaggerated and false stories are committed to writing, and these writings come down to us. This supposition might very plausibly have been made. But the evidence afforded by the series of quotations I have above described, cuts it off altogether. That long and uninterrupted series carries us irresistibly back to the very time when the events occurred. There is no time left for exaggeration and misrepresentation. We prove that the accounts which we now have were written on the spot, — that they were in circulation, and exposed to rigid scrutiny at *the very time in which the events themselves took place*, — and we are thus compelled to believe that the original records, made at the time, have been preserved unaltered to the present day.

"But does this," the reader will ask, "prove that the accounts are *true?*" Most certainly not. We have not yet attempted to prove them *true*. We have not yet come to the examination of the *evidence itself*, at all. The original witnesses, if we admit that these accounts were written by them, may have been mistaken, or they may have been false witnesses. We have said nothing yet on these points. The reader must bear in mind what is the precise point now up. It is simply to show that the accounts we have now, whatever they may contain, are *the very accounts which the witnesses themselves wrote*. The depositions are properly authenticated; not, indeed, by the common legal forms, — seal and signature and witness, — but by abundant evidence, — and

evidence of exactly the kind which is always most relied on, and entirely relied on in all other cases where the examination of very ancient documents comes up.* This point being thus settled, we are now prepared to examine the evidence itself, in reference to the other points I have mentioned. As it is very desirable, in order to have clear views of any argument, that a distinct view of its parts should be kept in mind, the reader is requested to look back to page 423, for an enumeration of the point, to be examined, and he will recollect that we have yet discussed only the first, and proceed now to the second.

2. We must ascertain that the writers of these accounts had distinct opportunities to witness what they describe.

Now in regard to this, their own testimony is to be taken. It is common to ask witnesses on the stand, in a court of justice, about the opportunity they had of knowing certainly, or the possibility that they might be mistaken, and they give their own account of the situation in which they were placed. This account is admitted and believed, like all their other testimony, unless something appears which shows that the witness is not to be trusted, and then *all his statements* are abandoned by the jury together.

If, however, it appears from the witness's own statements, that there was something in his circumstances or situation which prevented his having a fair opportunity to witness what he describes, or, if there was *anything* which might have operated to produce *delusion*, a jury would receive testimony with great hesitation. For example, suppose a witness should testify that he saw some supernatural appearance in going through a dark wood by night. Few would believe him, however honest a man he might be, on account of the great danger of being deceived in going through a scene full of irregular objects, such as the varieties of vegetation, the broken rocks, — the whitened trunks of decaying trees, — and going through too at night, when all forms are vague and indeterminate, and easily modified by the imagination or the fears. Again, an honest man, one in whose word

* See Note A. at the end of this Tract.

we place great confidence, may tell us of a cure for rheumatism. He says he has tried it, and it always does great good. We receive his testimony with great doubt, — because he cannot, probably, with the little experience he has, know how much the benefit he experienced was owing to the supposed remedy, and how much to other causes. If the same man should come from New York, and say that the City Hall was burnt, — that he saw it all in flames, or any other extraordinary fact; far more extraordinary than the efficacy of a remedy for rheumatism, we should believe him, if it was only a case where he had distinct and unquestionable opportunity to observe, and where no room was left for mistake or delusion. Now if we examine the miracles which our Saviour performed, and the opportunity which the disciples had of witnessing them, we shall see that there could not have been a mistake. Remember, however, that we are not now saying that their story must be *true*. We are only here showing that they could not have been *mistaken*. They *must have known whether what they were saying was true or not*. The case could not be like that of a man telling a ghost story, — something which he thinks is true, but which is, in reality, not so. The things done, were done in open day. They were done in presence of multitudes; and they were of such a nature, that those who witnessed them could not be deceived. Healing what are called incurable diseases, feeding multitudes with a small supply of food, walking on the sea, rising from the grave, after remaining upon the cross till Roman soldiers were satisfied that life was gone. Who could be a better judge of death than a Roman soldier? These and a multitude of other similar things, might be given as proofs that these witnesses could not be mistaken in what they described. They *knew whether they were true or not*. And, consequently, if the third point, that is, their honesty, should be proved, we must believe what they say. If they had informed us only of a few miraculous events, and those seen by a few people, — or of such a character as to render the witnesses peculiarly liable to be deceived, we might have admitted their honesty, but denied the truth of their statements. As it is, however, we cannot do this.

Not only were the facts themselves of so open and public a character that there could not be any mistake about them, but the writers of our accounts were eye-witnesses of them. They did not obtain a knowledge of them by hearsay or report. They wrote what *they themselves saw and heard.* It is noticeable that they themselves placed peculiar stress upon this circumstance. Luke begins his Gospel by saying, "It seemed good to me, *having had perfect understanding of all things from the first,* to write unto thee." John, at the close of his book, distinctly records the fact, that the *writer of the account* was one of the *principal actors* in the scenes he describes; — Peter, in his defence of himself before the Jewish authorities, says he cannot but speak the things he has seen and heard; — and perhaps the most striking of all is, that when the apostles came together to elect one to take the place of Judas, they restricted themselves in their selection, to those who had been, *from the beginning, witnesses of the whole.* "Wherefore," was the proposition, "of these men which have companied with us all the time that the Lord Jesus went in and out among us, beginning from the baptism of John unto that same day that he was taken up from us, must one be ordained to be *a witness with us* of his resurrection." These men understood the laws of the human mind in regard to believing testimony. They knew well what was necessary to make out a case — and they secured it.

We have now explained how the two first points in our chain of reasoning are established, and we may consider it as certain, in the first place, that, though our witnesses are not living, and, consequently, cannot present us their testimony in person, and although so long a time has elapsed, that their original writings are worn out and destroyed, yet that we have abundant evidence that we have the real account which they delivered; and, in the second place, that they could not be mistaken in the facts to which they give their testimony, as they were eye-witnesses of them, and the facts are of such a nature, that there could be no delusion. There is no possible way now, after these two points are established, by which their testimony can be set aside, except by the suppositi-

tion that they were impostors. This brings us to our third and last point.

3. We must have evidence that our witnesses are credible; i. e. that they are honest men, and that their word can be relied upon.

The evidence on this point is, if possible, more complete and more absolutely unquestionable than upon either of the others. The honest and candid manner in which they relate their story is evidence. It is plain, straight-forward, and simple. Their writings have exactly the air and tone of men conscious that they are telling the truth, but aware that it will be regarded with very different feelings by their readers. They narrate, frankly and fully, the events in which they or their companions were to blame, — and they do nothing more in regard to the guilt of their enemies. There are no palliating or extenuating statements or expressions on the one side, nor any disposition to apply epithets of odium or exaggeration upon the other. The story is simply told, and left to work its own way.

How differently do men act in other cases. How easily can you tell upon which side the writer is, when he gives an account of circumstances relating to a contest between two individuals or two parties! Open to any history of the Battle of Waterloo, or of the Campaign in Russia, and how long can you doubt whether the author is a friend or an enemy of Napoleon? Now turn to St John's account of the trial and crucifixion of the Saviour, a most unparalleled scene of cruel suffering, and there is not a harsh epithet, and scarcely an expression of displeasure, on the part of the writer, from the beginning to the end of it. You would scarcely know what was the writer's opinion. Take, for instance, the account of the choice of Barabbas by the Jews. Another writer would have said, "The Jews were so bent on the destruction of their innocent and helpless victim, that when Pilate proposed to release him, in accordance with their custom of having a prisoner annually set at liberty, on the day of their great festival, they chose a base malefactor in his stead. They preferred that a robber, justly condemned for his crimes, should be let loose upon soci-

ety, rather than that the meek and lowly Jesus should again go forth to do good to all." But what does John say? There is no attempt, in his account, to make a display of the guilt of the Jews. No effort to throw odium upon them. No exaggeration, — no coloring. "Will ye," says Pilate, "that I release unto you the king of the Jews? Then cried they all again, saying, not this man, but Barabbas. Now Barabbas was a robber."

In the same spirit is the whole account, — not only the narrative of this writer, but all the writers of the New Testament. It breathes a spirit of calm, composed dignity, which scarcely anything can equal. In the midst of one of the greatest moral excitements which the world has ever seen, and writing upon the very subject of that excitement, and themselves the very objects of it, they exhibit a self-possession and a composure almost without a parallel. Exposed to most extraordinary persecution, and consequent suffering, they never revile or retort upon their oppressors. It is impossible to avoid the conclusion, when reading the chapters of the New Testament, that the writers understood and felt the moral sublimity of the position they were occupying. They seem to have considered the little community in which they were then placed, and whose members did indeed, for that time, have control over their persons and their lives, — as, in reality, nothing to them. They felt that they were speaking, not to a few thousand contemporaries in Judea, but to a thousand millions of human beings, scattered over the earth, and coming, generation after generation, to read their story, — down to the end of time. They rise most effectually above all the influences then pressing so strongly upon them, and, in a calm and fearless independence, offer their testimony. They could not have done this, — it is not in human nature to have done it — had they not been sustained by this consideration, viz. they *knew that they were telling* THE TRUTH *on the most momentous subject ever presented to men, and* THAT THEY WERE TELLING IT TO THE WHOLE WORLD.

Another proof of their honesty is, that they were entirely disinterested; or rather, they were interested to

conceal the truth, not to tell it. Their testimony brought them nothing, and could bring them nothing, but reproach, and suffering, and death. They saw this in the history of the Saviour, and, instead of endeavoring to keep them unconscious of the sufferings that awaited them, he plainly and frankly foretold all, just before he left them. He told them in the most affecting manner, — the communication he made is recorded in the fifteenth and sixteenth chapters of the Gospel according to St John, — all that should befal them. "You must not expect," said he, in substance, "to find the world more kind to you than it has been to me. They have persecuted me, and they will persecute you. They will put you out of the synagogues, and whosoever killeth you, will think he doeth God service. I tell you these things beforehand, so that when the time shall come, you will remember that I told you, and be comforted then. I wish you to understand the dangers and trials that await you. You must not, however, be dejected or discouraged, because I have told you these things. It is necessary for me to go away, and it is necessary for you to encounter these evils. But it is only for a little time. The years will pass away swiftly, and, when you have done your duty here, you shall come to me again, and find a perpetual home with me and my father in a happier world."*

Such was the substance of this part of our Saviour's farewell address. His disciples listened to it in sadness, but they did not shrink from their duty. A very few hours after hearing these last words of their master, in their place of retirement, — they found themselves gazing in terror, and at a distance, at that dreadful throng which was pouring out of the gates of Jerusalem, to see their beloved master struggling upon the cross. They were overwhelmed by this scene; but terror triumphed only for a time. Immediately after the Saviour's ascension, we find them assembled, making calmly, but with fixed determination, their arrangements for future efforts, and waiting for the command from above. One hundred and twenty, in an upper chamber, planning a campaign against the world! They knew, they must have

* See Note B.

known, that they themselves went forward to suffering and to death. They went forward, however. They told their story. They suffered and died. And must not these have been *honest* men ?

The way in which men are *interested* is always to be looked at, in judging of their testimony. If a juryman is interested in the result of a trial, he is set aside. He cannot judge impartially. If a witness is interested at all, his testimony is received with a great deal of caution, or else absolutely rejected. And, whenever a case is of such a nature, that all those who were witnesses of the facts are interested on one side or on the other, it is extremely difficult to ascertain the truth. A very striking example of this is furnished by the circumstances of the battle of Lexington at the commencement of the American Revolution. Each of the parties, anticipating a struggle, and desirous of being prepared for it, had made efforts to get as much of the arms and ammunition of the country as possible into its own hands, and the British general in Boston, understanding that there was at Concord a supply of military stores, conceived the design of sending a party in the night to Concord to obtain it. He kept his design, or rather tried to keep it, secret. Late in the evening, the troops embarked in boats on the west side of the peninsula on which Boston is built, and sailed across the cove, to the main land.

This was done in silence, and, it was hoped, in secrecy. The Americans, however, in some way, heard of the plan. The country was alarmed. Men rode on horseback at midnight from town to town ringing the bells and calling out the inhabitants, and, by three o'clock in the morning, a number of troops were collected at Lexington, to oppose the progress of the British detachment.

Now, neither party wished to *begin* the contest. Like two boys, eager for a quarrel, each wished to throw the odium of striking the first blow upon the other. This difficulty is, however, usually, soon surmounted, and in this case, the musketry was soon speaking distinctly on both sides. After a momentary conflict, the Americans were dispersed, and the British moved on to the place of their destination.

Now, after all this was over, there arose the question, — not, in itself, very important, one would think, — but yet made so by those concerned at the time, "Who began this affray? Who fired *first*?" To determine this point, the American Congress are said to have instituted a formal inquiry. They examined witnesses who were on the spot, and saw the whole, and they found abundant and satisfactory evidence, that the *British* soldiers fired first, and that the Americans did not discharge their pieces until they were compelled to do it in self-defence. The British Parliament entered into a similar inquiry, and they came to an equally satisfactory conclusion, — only it happened to be exactly the reverse of the other. They examined witnesses, who were on the spot, and saw the whole, and they found abundant evidence that the *American* soldiers fired first, and that the British did not discharge their pieces until they were compelled to do it in self-defence. Now, the reason for this disagreement unquestionably was, that each nation examined only its own soldiers, and the soldiers on both sides were interested. Suppose, now, that there had been in the American army a considerable number who admitted that the first guns were fired from their own ranks; — suppose that, in consequence of this their testimony, they brought upon themselves the dislike of the whole army, and, to a great extent, of the nation at large; — how strong would have been the reliance placed upon such testimony. "There cannot be a doubt," the British would have said, "that you fired upon us first, — half of *your own troops* say so." This would have been a very fair inference. When men bear testimony contrary to their own interests or feelings, they are generally believed.

We have thus abundant evidence, from the great sufferings which the original propagators of the Gospel brought upon themselves, that they were honest men, and this completes the three positions necessary to prove that the Christian miracles were actually performed.

1. We are sure that the witnesses are honest men.

2. The facts are of such a nature, that the witnesses could not have been deceived in them.

3. It is proved that we have exactly the account which they themselves gave.

The miracles being once proved, the *divine authority of the religion* is proved, for no man can imagine that the Deity would exert his power in producing miraculous effects to give authority to a message which he did not send.

There is one other independent head of the external evidences of Christianity. It is the argument from *prophecy*. They who brought the communication which is offered to us as a message from heaven, said that they were endued with the power, not only of working miracles, but of *foretelling future events*. In some cases, human sagacity can foresee what is future, and even distant. They, however, professed to exercise this power in cases to which no human skill or foresight could have extended. Such a power as this is evidently miraculous, and they who possessed it, must have received it from the Creator.

One or two examples will clearly illustrate the nature of this argument. A great number of the prophets who appeared in the early years of the sacred history, foretold the coming of a Saviour. Precisely what sort of a Saviour he was to be, was not distinctly foretold,—at least, not *so* distinctly as to remove all misconceptions on the subject. So certain is it, however, that such prophecies were uttered, and generally published, that there prevailed throughout the Jewish nation, and even to some extent, in neighboring countries, a general expectation, that an extraordinary personage was to appear. We have evidence enough of this, not merely from the Scriptures themselves, but from a multitude of other writings, which appeared at that time, and which have come down to us by separate and independent channels. There can be no question, in the mind of any one, who will examine the subject, that the coming of Christ was predicted with so much distinctness, as to produce an almost universal expectation of the appearance of some very extraordinary personage. And the event corresponded with the prediction. A most extraordinary personage appeared. The most extraordinary, as all will acknowledge,—Christians and infidels,—that ever appeared upon the earth.

Our Saviour's prediction of the destruction of Jerusalem is another example. The scene was described with astonishing minuteness and accuracy, sixty or seventy years before it took place;—and there was, at the time of the prediction, no reason whatever, so far as human foresight could extend, to expect such a catastrophe.

Now, to examine fully this species of argument, several points ought to receive special attention. First, we must ascertain that the prophecy was really anterior to the event which is alleged to have occurred in fulfilment of it. This now, in regard to writings and facts so ancient as those of the Scriptures, is a peculiarly difficult task. Secondly, that the event is such a one as human foresight could not have foreseen. Thirdly, that there were not, in similar writings, a multitude of other prophecies *which failed*, and that those only have been preserved, which have apparently succeeded. Among the ignorant and vulgar, nothing is more common than a belief in the powers of fortune-tellers, or of the prophetic meaning of signs and dreams. The reason why this imposture retains its ascendency is, that the *few successful cases* are remembered, and talked about, and the cases of *failure* are neglected and forgotten. If a person predicts at random in regard to common events, he must sometimes be successful, and, if his votaries will forget the unsuccessful attempts, he may soon have the reputation of a conjurer. Now, we must ascertain that the prophecies of the Bible are not of this character, i. e. a few lucky predictions, among a multitude which failed. Fourthly, we must ascertain that the events themselves were not under the control of men, in such a way, as to enable those who were interested in the success of the prophecy, to bring about the corresponding result.

Now, to examine thoroughly all these points, so as really to form an independent judgment upon them, and to take nothing upon trust, requires, in some instances, no little maturity of mind, and, in others, no little scholarship and laborious research. Most persons must, almost entirely, take this argument upon trust. We can only explain its nature, and thus prepare the reader to exam-

ine more understandingly other works on this subject. We may however say that those who have gone into it most thoroughly, as is the case with all the historical evidences of Christianity, have been most convinced of the firmness of the ground. The most profound scholars in all Christian nations, have been the most decided in their belief of the Christian religion.

This completes the view which we intended to give of the historical argument. It would require a volume, to present the argument *itself* in all its detail. Our design has been to give our readers a clear idea of the nature of this kind of reasoning, not to make them minutely acquainted with all the facts upon which the various pillars of the argument are founded. And here we might rest the subject, were it not that there is one consideration which corroborates very much the conclusion to which we have come. The question very naturally arises in our minds, "Was this story believed at the time? It seems to be a plain case, that the disciples of Christ made out very decisive evidence of their divine commission, but the people who lived at that time, and upon the spot, had a much better opportunity of judging in this case than we have. — Now, did they believe this account?"

This is a fair question. It is always asked, in similar cases. A merchant will ask, "Is the report believed which was circulated on 'Change today?" "Was it generally believed in London, that such or such an event would take place?" And this belief or disbelief on the part of those who have the best opportunities of knowing, is sometimes regarded as the strongest evidence which can be procured. It is right, therefore, to ask whether the extraordinary story of the Christians was believed by those who were upon the spot, to discover error or imposture, if any was to be found.

The answer is, *it was believed*. The story spread with a rapidity to which no other revolution in the public mind can afford a parallel. When the hundred aad twenty assembled in their upper room, paganism was enjoying undisturbed and unquestioned possession of the whole Roman empire. Paganism reigned in every crowded city and in every distant province. Her temples crowned

a thousand summits, and the multitude, whose interests were identified with the support of her rights, might, at any time, arm themselves with all the power of the Cæsars to resist the encroachments of truth. *A hundred and twenty*, with the story of a crucified Galilean rising from the dead, came forth to attack this mighty fabric. And they prevailed. Opprobrium and ridicule, — gentle persuasion, — and stern menaces; — imprisonment, fire and sword; — torture and death, tried all their power. And with what did the fearless assailants in this most unequal war, attempt to contend against such an array as this. Why, simply with their own repeated declaration, *Jesus Christ did rise from the grave; and you ought to repent of your sins and believe on him.* And they conquered. "The truth is great, and it will prevail," said a Roman writer. He could not have found an example like this. The simple declaration of a sufficient number of competent witnesses, after a most energetic struggle, prevails over one of the greatest civil and military powers which the world has ever seen. Yes; the story was believed. It spread with unexampled rapidity, — and revolutionized the empire.*

NOTE A—page 429.

"When Kennicott undertook his great work of comparing several hundred Hebrew MSS. and editions, fifty years ago, all Europe was placed in the attitude of anxious expectation. One party who held (as Buxtorf had long before asserted,) that all the Hebrew MSS. the world over, were to a point and accent exactly the same, stood waiting, alternately agitated by the hope that the result would prove to be so, and the fear that it might turn out differently. Another party, who had been perpetually carping at the Hebrew text, accusing the Jews of having mutilated and interpolated it, and guessing what it *should* be, rather than learning to explain what it *was*, most eagerly expected a complete triumph over

* See Note C.

their opponents who had fought against this conjectural criticism, and doubted not that all the anomalies of Hebrew Grammar, and all the dark and difficult places of the Scripture would be thrown out.

Both were egregiously disappointed in the result. On the one hand, the various readings amounted to several hundred thousands: no two manuscripts or copies being found, which did not differ from each other in a multitude of places: on the other hand, not the one hundreth part of all this immense mass of various readings amounted, in point of importance, to anything more, than the question whether the word *honor* shall be spelled with or without the letter *u*.

What Eichhorn said long ago, when remarking on the changes which Bishop Lowth had made in the text of Isaiah, appears to me very judicious, and strictly correct, viz. that *the better any one understands the Hebrew text, the less will he feel the need of emendations, and the less probable will they appear.*" — [*Professor Stuart's notes to his Translation of Dissertations on the study of the original languages.*

NOTE B—page 434.

The following brief summary of the labors and sufferings of the Apostles illustrates this part of our subject.

"The first of the Apostles that suffered martyrdom, was James, the son of Zebedee. It is said that a remarkable circumstance, attended his death. The man who had drawn him before the tribunal, observing with what readiness he submitted to martyrdom, was struck with remorse, shortly turned, himself to Christianity, cheerfully confessed Christ, and was beheaded with the Apostle. The other, James, was preserved to a much later period. He was pastor of the church at Jerusalem, and obtained the name of Just, on account of his remarkable innocence and integrity. His martyrdom took place in the year 62, a short time subsequent to the publication of his Epistle. The principal men of Judea, enraged at the vast increase of Christian converts by his means, were desirous of obtaining some pretence for putting him to

death. Accordingly, they persuaded him to mount a pinnacle of the temple, and make an address to the people, then assembled at the Passover. James, being placed aloft, delivered a frank confession of Jesus as then sitting at the right hand of Power, and who should come in the clouds of heaven. Upon this, Annanias and the rulers being greatly incensed, cried out, and threw him down and stoned him. The Apostle had strength to fall on his knees, and pray, 'I beseech thee, Lord God and Father, for them, for they know not what they do.' One of the priests moved at the scene, cried out 'Cease, what do you mean?' This good man is praying for you.' A person present with a fuller's club, beat out his brains, and completed his martyrdom.

"The great Apostle Paul, having zealously preached the Gospel for nearly thirty years, and sustained innumerable trials, conflicts, and sufferings, was slain with the sword, by the order of Nero. The last view we have in Scripture of St Peter presents him at Antioch. This was probably in the year 50. From this time, till his death, he was principally employed in spreading the gospel among his own countrymen. In the year 63, he came to Rome, where he wrote his two Epistles, a short time before his death. When Paul was martyred under Nero, Peter suffered with him. He was crucified with his head downward, a kind of death, which he desired, from a conviction of being unworthy the honor of suffering in the same manner in which his Lord had done. Of the labors of the eight Apostles, Andrew, Philip, Bartholomew, Thomas, Matthew, Jude, Simeon, and Matthias, nothing in particular is recorded. Of the Apostle John, a few valuable fragments may be collected. He was present at the council held at Jerusalem, in the year 50; and probably did not leave Judea till that time. Asia Minor was the great theatre of his labors, particularly Ephesus.

"Tertullian relates, that by order of Domitian, John was cast into a caldron of boiling oil, and came out without receiving any injury. Domitian then banished him to the solitary isle of Patmos, where he was favored with the vision of the Apocalypse. After the death of Domi-

tian, he returned from Patmos and resumed his labors in Asia Minor."

NOTE C —page 440.

PROPAGATION OF CHRISTIANITY.

The propagation of Christianity was in itself wonderful, as it is the only religion which has ever been propagated purely as such, without extraneous aid. Heathenism requires no change of heart or life. It has no creed, no general belief except what may be found in fabulous traditions of a remote antiquity. It was a creature of human mould, contrived for political purposes, carrying with it abundant evidence, that its design was to strengthen certain forms of government, giving to the few power over the many, by enveloping the great mass of the people in darkness.

The progress of Mohammedanism, which has been the established religion of many nations for more than ten centuries, was simply the triumph of the sword. Christianity is the only religion which has sped its course and is fast extending its influence through the earth simply by instruction and persuasion. Its intrinsic worth and its adaptedness to the wants of our race are but to be presented, and its claims are allowed.

The rapidity and extent of the propagation of Christianity prove its divine origin. On the first day of its public promulgation multitudes assembled, and so clear, so convincing were the arguments presented, that with the divine blessing, three thousand embraced the christian faith, and many continued to be added daily.

Before the end of thirty years this religion, which originated in an obscure province of the Roman Empire, and whose first ministers were unlearned men, had spread not only through Palestine, but through nearly all the numerous districts of lesser Asia, through Greece and the Ægean isles, along the sea coast of Africa, on to Rome. Great multitudes in Antioch of Syria, at Joppa, Ephesus, Corinth, Thessalonica, Beren, Iconium, Derbe, Antioch in Pisidia, Lydda and Samos, renounced paganism

and became worshippers of the true God. So far, these facts are collected from sacred narrative, and ecclesiastical and profane history agree in their testimony respecting its rapid spread. Tacitus, Suetonius, Juvenal, Pliny, Martial, Marcus and Aurelius speak of it. Tacitus says "this pernicious superstition spread not only over Jordan but through Rome also. Pliny the younger wrote about 40 years after Tacitusand gives testimony of the same character. He was an officer of the Emperor Trajan in the distant province of Bythinia, and the number of Christians there who were brought to trial on that account, and most severely tortured and punished, was so great, that he sent to Rome for advice. He wrote, "the contagion of superstition has spread not only in cities but in villages and the country; persons of all ages and both sexes, and more still will be in the same error." He adds, however, that he does not think it impossible to check and to correct it. Tertullian and Origen, from A. C. 130 to 230, describe the doctrine as "filling cities, islands, towns, boroughs, the camp, the senate and the forum." They then state there was not "a nation, Greek or barbarian or of any other name, even of those who wander in tribes or live in tents, where the Christian religion was not triumphant." Among the Moors or Gaetulians of Africa and the people on the coasts of Spain, in several nations of France, in parts of Britain inaccessible to the Romans, among the Sarmatians, Germans and Scythians many christian converts were found.

Seventy or eighty years after Origen, 312 A. C., Constantine the Great, Emperor of Rome, embraced Christianity, and in 20 years it was nominally the religion of the whole empire.

Ten years later, says Jerome, "Until the resurrection of Christ, in Judah only was God known and his name was great in Israel, but now Jews, Greeks and Latins, Indians, Persians, Goths and Egyptians believe in immortality; Thracia and Scythia are now softened by the Gospel." Can such success be other than divine?

SCIENTIFIC TRACTS.

VOL. II......NO. XIX.

LIFE OF PETER THE GREAT,

EMPEROR OF RUSSIA.

CHAPTER I.

It will be impossible duly to appreciate the character of this great man, without an acquaintance with the situation of Russia, previous to his accession to the throne. It is only by comparison, that the effects of his genius and energy can be understood. Peter inherited one of the most extensive empires of the earth, but the climate was cold, the soil rigorous, the inhabitants almost barbarians. Under the sceptre of Peter this immense domain rose to a flourishing, powerful, and polite nation. The arts and sciences were cultivated, blooming fields attested the skill of the agriculturist, and the Russian canvas was unfurled to the breezes of almost every sea.

The early history of Russia, like that of almost every other people, is lost in the obscurity of fable and foolish tradition. The country was formerly called Muscovy, but took the name of Russia probably from the word *Rossa*, which signifies *collected together*, because of the great diversity of tribes with which it was peopled. The first authentic accounts of this people, describe them as warlike and ferocious, different tribes being governed by independent rulers. In the 10th century of the Christian era, Wolodimer obtained the sovereignty of all Russia, and assumed the title of Great Duke. At his death, however, the kingdom was again divided, and his sons became independent sovereigns of separate pro-

vinces. Jealousies and feuds sprung up among them, and they engaged against each other in unnatural and exterminating wars. While thus contending, they were attacked and subjugated by an immense army of wandering Tartars. In this ignominious bondage they remained until the year 1500, when their country was liberated by the bravery and military skill of Duke John, who, after many bloody contests overthrew the power of the invaders and brought the whole country under his own control. The warlike prowess of his successors added a few small territories to their immense domain. Among these were part of Livonia, and several provinces of Persia, skirting the shore of the Caspian Sea.

The son of Duke John was sur-named the Tyrant, from the malignity of his temper, yet his accession to the throne was a happy event for this people. He first framed a code of laws; for previously, the Russians had no law but the will of their sovereign. From this time to the reign of Peter, a succession of sovereigns were seated upon the throne, and the history of their reigns is but a history of tumult and wretchedness and war.

The different tribes inhabiting the vast territory called Russia, spoke different dialects. These however eventually were combined into one general language, a dialect of the Scandinavians. Their language, however, was rude and uncultivated.

The early religion of the Russians was idolatry. They had numerous gods and foolish and cruel superstitions, which had no effect in restraining vice or in encouraging virtue. Fierce and bloody barbarians, they wandered about, having little employment but war. In the year 1804, the Patriarch of Constantinople proclaimed the conversion of the Russians to the Greek Church. It was indeed true that some of the Russian chiefs had professed conversion to the Christian faith, but little evidence can now be found of any spiritual conversion, and it is certain that many years after this, the great body of the Russian nation remained undisturbed in their cruel superstitions. In the year 955, Alga, empress of Russia, professed the Christian religion, and with several of her

courtiers, was baptized. She made vigorous, though for a time, unavailing efforts, to propagate the mild sentiments of Christianity, instead of the savage rites of ancient worship.

Many of her family contrived to multiply the monuments of idolatry, and to discolor them with the blood of human sacrifices. On these altars many a Christian bled, to propitiate the merciless deities of the north. But the example of Alga and her pious instructions produced an impression, which the blood of human victims could not wash away. Greek missionaries with great zeal preached Christianity, and converts were rapidly multiplied. Christianity, thus introduced, spread rapidly, and very soon overthrew the old religion, and stood upon its ruins.

The domestic manners of the Russians were originally barbarous in the extreme. But the influence even of a corrupted Christianity softened the asperities of their habits. The manners of different tribes differed. Generally a savage horde of fifty or sixty, wandered together, seeking pasture and engaged in rapine. Domestic enjoyment was a thing unknown, and marriage was but the servitude of the unhappy wife to her cruel and tyrannical lord. The conversion of the nation to Christianity, was, for the most part, merely nominal. Yet previously to Peter's accession to the throne, a very considerable change was taking place in the habits of the people, and though the obscure parts of the empire still remained in unbroken barbarism, the immediate court of the prince was adorned with no inconsiderable refinement.

CHAPTER II.

Peter Alexiowitz was born the eleventh of June, 1672. At 10 years of age, the death of his brother Theodore, left the throne of Russia to him. Though he was proclaimed Czar at this early age, his right to the throne was for a time disputed. He had an elder brother, John, upon whose brow, by natural descent, the crown would rest. But in consequence of imbecility of body and of mind, he was judged incapable of the government, and the reins of empire were placed in the hands of this

youthful hero. Sophia, the sister of Peter, conscious that she could but little control the vigorous and independent mind of Peter, excited a rebellion, which, after the effusion of much blood, resulted in making the throne *carry double*. The two boys were placed upon it. Thus situated, Peter's early education was very much neglected. He was surrounded by a crowd of obsequious flatterers, whose only object was to please him, that they might aggrandize themselves. There can hardly be a more unfavorable situation, for acquiring cultivation of mind, and worth of character, than the court. But in the case of Peter, there were peculiar difficulties. His ambitious sister Sophia did all in her power to repress the rising energies of his mind, for she daily saw proof, that he was capable of becoming one of the most powerful of princes. But the native vigor of his mind could not be chained. It broke from every restraint. It surmounted every obstacle. It gained strength from those very difficulties which were intended to discourage and weaken. In his early sports he manifested quite a predilection for military tactics; neither did he appear to use his drum and his sword as other children do, merely for diversion, but that he might become acquainted with the duty of a soldier. An interesting anecdote is related respecting his fear of water. Riding, when quite a child, in his mother's arms, he was suddenly awaked from sleep, by the noise of a water-fall near which the coach was passing. The fright was so great that he was thrown into a fever, and for many years, he could not, without the greatest terror, approach running water. In the following manner his antipathy was overcome. One fine day Prince Boris Galliczen, his governor and chief favorite, persuaded him to ride into the country, and partake in a hunting match, without informing him that there was any brook near the place. After a little diversion, Galliczen cried out, "What hot weather! oh that there was a river at hand that I might jump in and bathe!" "How," said the young czar, "would you kill yourself?" The prince answered, "I have frequently bathed with your father, and yet your majesty sees me alive. Nothing can be more wholesome in sultry weather." The czar was surprised,

and coldly replied, "I have heard that people are frequently drowned." — "Ay," said Galliczen, "but not in water scarce so high as one's knees. If you please, sir, I will send somebody to look for a stream, that you may see that it is possible to bathe without drowning." The brook was easily found; the czar rode towards it trembling, and stopped his horse a good way off. Galliczen ordered some men to cross it on horseback, forwards and backwards; upon which the czar ventured to ride nearer. The prince seeing this, rode through himself, and ordered some of his people to cross it on foot. They did. The czar wondered at what he saw; but at last had the courage to ride his own horse over. Pleased with what he had performed, he from that time used himself to the water, till, by degrees, he got quite rid of this troublesome antipathy.

Sophia, finding all her efforts to paralyze the growth of Peter's mind unavailing, headed a conspiracy against the life of her brother. The conspiracy was fortunately discovered just in time to save the life of the young prince, and Sophia was shut up for the remainder of her life in a monastery. When eighteen years of age, the young monarch was married to Ottohessa Federowna, and had by this time obtained such an ascendency, that though nominally associated with his brother, he was in reality sole monarch.

The emperor about this time became acquainted with a young Swiss gentleman of great personal merit. M. Le Fort was a man of uncommon genius and of cultivated mind. His acquaintance with the manners and customs of the more enlightened nations, made him an invaluable friend and adviser of Peter. At his suggestion the soldiers composing the life guard of the czar were clothed in a more convenient garb, and trained to perfect discipline, to which before they were almost entire strangers. Peter coming from his chamber one fine morning, saw his company of life guards paraded before the palace, glittering in beautiful and convenient uniform, and performing the evolutions of military service, with all the skill and regularity of trained veterans. He was so delighted with this animating spectacle, and saw so evi-

dently the increase of power which it would afford him that he immediately ordered a suit of uniform to be made for him, and entered the ranks as a private. He was indefatigable in his exertions to become acquainted with the duties of a soldier; and very soon excelled all his comrades in the exercise. When upon the parade ground he would allow not the least difference to be made in his favor, but subjected himself entirely to all the rigor of military discipline. How few young monarchs have ever showed a spirit like this! The energies of such a mind the opposition of a world could not repress.

The advantages of this discipline were so evident that Peter determined to have all his troops trained in a similar way. To accomplish this he spared no expense, and had too much magnanimity to be influenced by that foolish national pride, which refuses to learn from others. He immediately sent to Amsterdam, Geneva and other places, to engage foreigners of distinction skilled in warlike arts, to come and instruct his army. With the vigor of a great mind, he drove impetuously onward with his well devised schemes, and lost no time in pusillanimity and delay. With him, to form a plan was but the precursor of its immediate execution; difficulties did but spur him on to greater effort. In a short time the rules of discipline were introduced to his whole army, and Russia looked upon a different set of troops from what she had ever seen before. The rank which Peter took in his army and the discipline he underwent was not a vain show. He absolutely forbid the commander to remember at all his regal rights, but to treat him in every respect as the rest of the soldiers. And the commander knew that the directions of Peter were not to be slighted; he knew that the least appearance of partiality would be followed with immediate punishment. Thus was he elevated in the army by personal merit alone. He passed through the hardship and the fatigue of all the various duties of a soldier, ascending from rank to rank by well earned promotion, till he was placed in the highest office —the office to which by birth he was entitled.

Though Peter was totally averse to the pomp and splendor of outside show, he endeavored, and successful-

ly to introduce the refinements of the politer nations, and was pleased in beholding the rapid increase of all those improvements which were adorning the territories of his more enlightened neighbors.

While things were in this train, an accidental circumstance led Peter upon a new enterprise even more difficult than the former, and one for which we shall in vain seek a parallel in the history of monarchs. As he was visiting his summer-house on the borders of a beautiful lake, he saw a small English vessel floating there, which for a long time had been neglected and useless. The idea at once entered his mind, that Russia must have a fleet as well as an army; though then there was only the White Sea, upon whose bosom his fleet could float. But how was he to obtain a fleet? His people were ignorant of ship building. He had no ship carpenters no foundries, no suitable canvas, no appropriate cordage. How then was he to give to Russia a powerful fleet? His mind was already made up that the thing must be done. Before the resolutions of such a man, all common obstacles are compelled to give way. It is only men of weak and enervated minds, who can see nothing but the *difficulties*, and who form plans but to give them up. Peter adopted the astonishing resolution of stepping from the throne and laying aside the sceptre and himself learning the trade of a ship carpenter. He arranged the affairs of his government in such a way that he could with safety be absent. Before he set out he gave a remarkable proof of his wisdom and penetration in sending abroad all the principal young men of his empire. Fearing that during his absence they might excite insurrection, he thought it best that they should be sent away and he could not fail to perceive the beneficial influence they would exert after several years' acquaintance with the manners and refinements of wiser nations. Accordingly the most powerful young men of his empire were scattered all over Europe, each one having a particular branch of study to which he was to devote his chief attention. Their expenses were defrayed at the public charge. It is not to be expected that his ignorant subjects should have appreciated these improvements, or

that they should not have opposed them. Many of these young men were exceedingly reluctant to enter upon foreign travel, and while Peter was thus laying the foundation of glory and of greatness, many conspiracies were formed against his life.

When Peter was twentyfour years of age, his brother John died and left him the undisputed and independent sovereign of the realm. In May, 1697, the Czar commenced his important travels to acquire the knowledge of ship building, and all other arts which might usefully be introduced to his people. The administration of the civil government was left in the hands of three of his nobles. In making preparations for his tour, a difficult question arose respecting the character in which he should appear. His real one, that of emperor, would by no means do, because it would prevent his inspecting personally into minute things, would burden him too much with ceremony, and besides would be very expensive: all which objections were made by his majesty.

Some proposed that he should travel as a great priest; others were for the disguise of an Arminian merchant, and others, for that of a private gentleman. But at last M. Le Fort thought of a method which the Czar immediately approved, as it was consistent with the honor and safety of his person, and would yet give him all the opportunity of concealment he could desire. It was, that his majesty should send a solemn embassy to all the courts he intended to visit, with compliments and proposals of friendship and commerce; and that he should travel *incognito* in the retinue of the ambassadors, under the protection of the said embassy, whereby it would be known that he was personally present, at the same time that he was at liberty to receive just as much ceremony as he saw convenient. Le Fort was at the head of this embassy, as he was acquainted with the manners and customs of foreign countries and master of many languages. The route of the embassy was to be through Prussia, to the coast of Berlin; thence to Holland; from Holland to England and back again; then to Vienna, and last of all to Venice. As he entered the capital of one king-

dom after another, the embassy was received with many marks of attention. Peter, however, did not waste his time in show and parade. He usually appeared in the dress which did not distinguish him from his attendants. When in seaports, however, he usually went about dressed as a Dutch skipper, that he might more freely and unrestrained visit the yards. As he passed from dock to dock none could dream that the apparently humble Dutch skipper, was in reality the monarch of Russia. Every moment of time he endeavored to improve in collecting every species of information which might prove useful.

When the embassy arrived at the Hague, they were received with great magnificence. The ambassadors appeared in the richest dress, while his majesty rode disguised in the train, wearing a plain blue coat, a large white periwig, and a white feather. From the Hague he rode privately back to Amsterdam, and entered himself at the admiralty of Indies as a common ship carpenter under the name of Peter Michaeloff. He now entirely laid aside every appearance of sovereignty and labored in the ship yard with vastly greater assiduity than any of his comrades. None of them could be impelled by the powerful motives by which he was actuated. Still he could not be disguised. Everybody knew him. The laborers in the yard regarded him with unbounded deference. There was a majesty in the undertaking in which he had embarked which commanded respect. In the ship yard of Amsterdam, with the tools and the apron of the mechanic, the character of Peter shone with a brilliance more dazzling than when Russia's crown of diamonds, was sparkling on his brow. It was with difficulty that people were restrained from coming about him, or standing to gaze at him, the spectacle of an imperial apprentice to a ship carpenter was so novel. The czar occupied a little obscure tenement on the India wharf, and no importunities could persuade him to leave it for a more princely residence. When not actively employed with the axe, he passed his time in instructive interviews with gentlemen of merit, or in amusements, by which he might acquire skill, which would be of practical utility.

The king of England, at this time in Holland,

was an accurate observer of the actions and views of this wonderful prince. The acquaintance of the two monarchs afforded mutual satisfaction, and the czar received a cordial invitation from the King of England to visit London. This invitation his Russian majesty accepted.

While the czar was thus using the tools of the ship carpenter, most of his retinue had been sent away into different parts, all having their particular routes prescribed, and the arts to which they were to apply. His majesty was too ardent and too deeply engrossed in the object of elevating his country, not to be impatient of delay. He could not wait till his own people were sufficiently instructed, to transplant the arts and sciences into their country, but wherever he found artists of skill, he held out to them good encouragement, to enter his territories. As he visited country after country he was continually sending learned and skilful foreigners home to his own people. Everybody with him was compelled to be busy. His servants were not suffered to be idle. Some were sent to school to obtain the common branches of education. Others were bound for a certain term of years, to skilful mechanics, and all were active in acquiring some useful knowledge. What a contrast in the manners and habits of this man, to the luxury and dissipation, which too often disgrace the monarchs of Europe.

Peter arrived in London in 1697, being then 25 years of age. William the Third, of England, received him with many demonstrations of respect. The czar remained in England three months, visiting all the works of public importance. Nearly all the mechanic arts were minutely investigated, and thorough workmen hired to move to Russia. Every moment of his stay in England was devoted to useful objects, and he left that highly enlightened people, having obtained a mass of information, of inestimable value to his subjects. From England he went to Vienna, thence through Germany, and was on his way to Venice, when he was recalled to Moscow by the intelligence of the revolt of 40,000 of his people.

But Peter was not a man to be discomfited. Before his enemies dreamed of it, he was in the midst of them and they were vanquished.

The vast projects, which had long been revolving in his majestic mind, now began to appear in their practical influence. Peter had a vast territory and a numerous people, but wild, ignorant and uncultivated. Everything was to be done. A nation was literally to be made. His people, long accustomed to their old habits, were exceedingly averse to innovation. Long accustomed to indolence, they shrunk from toil. Inured to misery, they hardly thought of any improvement in their condition. But a monarch who had sufficient resolution to abdicate the splendor of a throne for the toil of the ship-yard, could not be discouraged by such obstacles as these. He persevered without any doubt of success in his wise plans, though the most trivial alterations, such as retrenching their ancient and inconvenient dresses or shaving their long beards, met with the strongest opposition, and were sometimes sufficient to cause an insurrection. To rule such a people, required a rigor which in other cases, would have been unjustifiable. Mildness would by them have been considered effeminacy, and would only have excited contempt. The principal reformation he introduced during the winter of his return to Moscow, were, 1. In his revenue; 2. In the habits and beards of his subjects; 3. In ecclesiastical affairs; and 4. In several customs relating to civil society.

1. The collecting of the revenue had previously been entrusted to the nobility, and this power was exercised by them to the great oppression of the people, and with great frauds upon the crown. By the regular organization of a corps of responsible collectors, this evil was in a great degree remedied and the public treasury well replenished.

2. The general habit of the Russians, was a long garment like a cloak, hanging down to the ancles, and gathered up in plaits at the hips. This garment was inconvenient and ungraceful. The czar gave orders that it should be changed, and prohibited any one to approach the Court who was not furnished according to his ability, with handsome clothes, after the English mode. He also commanded, that at every gate of the city of Moscow, suits of clothes in the English fashion should be

hung up, and that all persons, excepting the peasants who brought in provision, should dress themselves after those patterns. The fashion of the court, soon becomes the fashion of the capital; and the fashion of the capital is soon imitated throughout the empire. If any one was found with uncurtailed robes, he was compelled to pay a fine of about two shillings, or to kneel down and have his skirts cropped. Many hundreds of garments were thus curtailed, and the mirth which was thus excited, aided to keep the people in good humor, and in a short time the more commodious and becoming fashions of England were in universal use. In the dress of the ladies he made equal alterations, but they seemed not at all opposed to a new fashion.

But when the czar attacked the long and smoothly combed beards of the poor Russians, they recoiled with horror. Such was their veneration for this ornament, that they deemed the efforts of Peter to remove it, an atrocious sin. Many positively refused submission, and had their beards plucked out by the roots for their obstinacy. Some were so superstitious as to preserve their beards after they were cut off, to be deposited in the coffin with their remains. By degrees, however, they became reconciled to this deprivation; probably aided by the fact that the alteration was universally applauded by the ladies.

3. In ecclesiastical affairs, a change was made which excited for a time much commotion. The Patriarch of the Muscovite church was endowed with great power and splendor. In England, Peter had seen how much the authority of the prince was augmented, by being at the head of the church. He resolved to take this power into his own hands. A favorable opportunity soon presented itself, in the death of the aged Patriarch, and Peter refused to have a successor elected. Thus Peter became the *Defender of the Faith*, but the consequence of this alliance was, that religion became merely a political engine.

4. In the customs relating to matrimony, he introduced very great reformations. "Matches, till now, were always made up by the parents, without any previous

meeting of the young couple, who frequently were not above 13 or 14 years old. The bridegroom never spoke to the bride till the day before the nuptials, and then the visit was very short, and in presence of all the friends on both sides. But the Czar observing that the marriages in Russia were often remarkably unhappy, very justly attributed it to this cause. He therefore ordered that no young couple should be married without their free consent, nor till after a correspondence of at least six weeks. This regulation had a very good effect. Husbands before would beat their wives so inhumanly, that they often died of the blows, and the man never suffered for the murder, which was interpreted as done by way of correction. But these barbarities in a great measure were now prevented, and fewer women suffered for the murder of their husbands than before.

Previous to the accession of Peter to the throne, there were in Russia no universities, and no schools worthy of notice. Of course literature was unknown. One of Peter's predecessors had established a printing press in Moscow, but it was set on fire and destroyed, as was generally supposed, through the influence of the priests, who were desirous of retaining the dominion of ignorance. The following anecdote illustrates the ignorance of the people. The secretary of the Persian ambassador calculated an eclipse. He proclaimed the hour of its appearance, and its duration. At first it was universally believed that no mortal could know so much. But when the prediction was actually verified, and the gloom of the darkened sun began to appear, the crowd thronged the house of the ambassador and demanded the person of his secretary, that they might burn him as a sorcerer. The vigorous measures of Peter rapidly changed this state of ignorance. Books were printed and widely circulated; schools of a high order were established; and the elevated branches of refined education were taught.

Another very important change was at the same time introduced by this wonderful monarch. The Russian year commenced with the first of September, while in all the other parts of Europe the year commenced with January. The simple-hearted Russians thought the world

must have been created in autumn, when the fruits were ripe, or Adam would have starved. They seemed unconscious that Russia was not the whole world, and that while it was summer in one hemisphere it was winter in the other. But whatever Peter undertook he usually accomplished, and he resolved to conform to the rest of Europe in the mode of computing time. On the first of January, 1700, he proclaimed a jubilee, and commanded it to be solemnized throughout the empire, for one week, with the utmost magnificence. The ringing of bells, firing of cannons, brilliant illuminations, public festivities of every nature combined to impress this event upon the public mind, and to make it a prominent epoch in the history of Russia. He then ordered, that from that time, the year should commence with January, and that no date should be used but that which was followed by the other nations of Europe. The violater of this law exposed himself to a severe penalty.

Similar changes were effected in the army and in the navy. All the troops were now disciplined and regularly clothed, and that every man might be blessed with employment, he appointed those gentlemen who were living in idleness, to different stations in the army or navy. These changes at first were very disagreeable to the Russians, and excited many tumults. But Peter was not a man to be intimidated, and the beneficial results soon silenced all opposition, and wave of improvement succeeded wave in rapid and continued succession.

CHAPTER III.

In the year 1700, Peter proclaimed war against Charles XII. King of Sweden. Charles was then a youth of eighteen, but he was a youth in years only. He had a fearlessness and an energy, which again and again sent discomfiture into the armies of Russia, and compelled the respect of her powerful monarch. When two such men as Peter the Great, and Charles the Twelfth array their energies against each other, the destruction must be terrible. It was so. For twenty years the demon of war scattered pestilence and death over those two countries. For twenty

years the fury of battle almost incessantly blazed. The motives of the Czar in this war were very unjustifiable. The desire to extend his territory that he might have harbors for his navy, and better facilities for commerce, spurred him on to what must be denominated atrocious crime. His conduct in this respect is capable of no extenuation, and deserves unmingled abhorrence. There is no evidence that Peter, in his magnanimous plans for reform, was actuated by christian principle. Native greatness of soul impelled him to majestic undertakings, but there is no evidence of those internal feelings of the heart, upon which Heaven could look with approbation. On the contrary, he was little regardful of the means by which he accomplished his ends. To elevate his nation,—to be the monarch of an enlightened and mighty people,—was the object of his aspiring ambition. And this object he pursued, with a wisdom of design, a fearlessness and an energy of execution, an untiring and unintermitted perseverance, which render him one of the most astonishing men the world has ever beheld. If true christian benevolence had sanctified his objects, and piety of heart had controlled the means he used, all would have cause to bless and none to curse his memory. But alas, the spirits of ten thousands slaughtered upon the battle field, might rise and point to Peter, and say "*thou art our murderer.*" Yes, Peter deluged the plains of Russia and Poland with blood. Ah! how many groans ascended to Heaven from the field of carnage. How many were made widows and orphans by his ambition, and were compelled, in poverty and friendlessness, to drain affliction's bitter cup. Providence overruled the ambition of Peter to make it promotive of the best, the spiritual interests of the world. But it is a melancholy thought that this great man had but little reference to his Creator, in the vast schemes with which his mind was occupied. His unjustifiable war with Sweden was spitefully conceived, and prosecuted with tremendous energy. But Charles of Sweden was a man capable of coping with Peter of Russia, and as his soldiers were more highly disciplined, and possessed of more native valor, he in a long succession of battles sent discomfiture into the Russian forces. These

continued and rapid defeats, however, did not in the least chill the ardor of Peter. He seemed to consider the lives of his subjects nothing, compared with the accomplishment of his ends, and coolly remarked, "I know very well that my troops will be beat for some time; but this will teach them to conquer at last." The mournful details of war in this brief sketch must be omitted. It is dreadful to linger in imagination around the battle field. The frantic plunges of the wounded horse; the crimson herbage and pools of gore; the scattered limbs and mangled bodies of the slain; the convulsions of the dying, and the heart piercing shrieks which from every direction fall upon the ear, compose a picture too terrible for contemplation. And when the mind wanders from that field to the months and years of misery, which it must send to unnumbered families, the heart sickens, and we are ready to affix the title of monster and of demon to the man who can cause such wo. The heroes of unjustifiable war are but murderers on a great scale; and when we look at this part of the character of Peter, it must be admitted that he was a royal murderer. If he had stolen his neighbor's purse, he would have been called a *thief*, and as he stole his neighbor's country, we must call him an imperial robber.

One event occurred in his wars, which deserves particular notice. At the taking of Marienburg in 1702, a young female, whose baptismal name was Martha, was taken captive. She was of humble birth, and had been a short time wedded to a dragoon in the Swedish army. Martha was but eighteen years of age, and possessed of many attractions, both of person and mind. The day after her marriage the town was taken, and she was made a captive. Her husband was rendered inconsolable by her loss, and despairing of ever seeing his beloved wife, said "that he would never go to that place, where for a few days he had been the happiest of men, as he was now the most unfortunate; but would seek death in Poland, where his master would give him opportunities enough of meeting it."

Peter saw Martha one day in the service of one of the officers in his army, and was struck with the answers she made to his interrogatories. He was so much pleased

with her appearance, that he took her home to his own house. A farther acquaintance with her merits increased his admiration, and despising the weak prejudices respecting birth, he made her his wife. When she professed the Greek religion, she received the name of Catharine. By the greatness of her mind and her engaging behaviour, she became the entire mistress of her husband's passions and affections. Benevolent and amiable in her feelings, she was not rendered haughty by her elevation, but became the friend of the friendless and the protector of the oppressed. She often interposed in favor of those who had incurred her husband's displeasure, and by her winning solicitations saved the lives of many persons. She became the universal favorite of her subjects, and retained till her dying hour the undiminished affection of her imperial partner. In all the dangers and fatigues to which her husband was exposed, she was his companion. She accompanied him even to the field of battle; and after an engagement she might be seen followed by her servants, administering to the necessities of the wounded and the dying. The religious order of St Catharine was instituted by the Czar in honor of his lady. Catharine was in every respect a congenial companion for her husband, and had sufficient capacity of mind to comprehend his vast schemes, and ability to render efficient aid in carrying them into execution. At the death of Peter the empire was left to her, and for several years she reigned with great wisdom.

When the Czar had taken Notteburg in the year 1702, he observed about a mile below at the mouth of the river Neva several low muddy islands. Here, he thought, would be a convenient location for a new city, which might open to his empire the navigation of the Baltic. The Czar accordingly attacked the Swedes, and after a bloody battle drove them away. Having examined the islands and the coast, he immediately commenced building an imperial city, to be the seat of his own residence.

Nature seemed to have done everything to render such a project impracticable. But Peter formed his plans, and executed them, without being intimidated by any obstacles, however apparently insurmountable. These islands

were desert and uncultivated—in summer nothing but a heap of mud, and in winter a frozen pool. The climate was exceedingly severe, the summers short, the winters long and tempestuous. There was no approach to the place, but through immense forests, and wild morasses, filled with bears, wolves and other beasts of prey.

But Peter had resolved to found a city there, and to call it in honor of himself, Petersburg. He did not wait the termination of the war, but immediately commenced operations. He drew himself the plan of the town, the fortress, the port, the quays, and the castle which defended the entrance. In less than one year's time, above 300,000 men were assembled by the Czar from the most distant parts of his dominions. The peasants of Astrachan and those who inhabited the frontiers of China, were transported to Petersburg. At one time a tremendous inundation swept away all his works. But Peter was not discouraged. Again a dreadful pestilence, bred by the marshes he was endeavoring to drain, hurried over a hundred thousand to the grave; still Peter persevered without the least diminution of ardor. His workmen were semi-barbarians drawn from the extremities of his empire, and by their ignorance were continually frustrating his plans. Perhaps no other man has ever lived, who, under equal discouragements, would have persevered. But nothing could shake the Czar's fixed resolution. Posterity now looks with amazement upon the magnificent capital, founded in defiance of so many obstacles. In three years from the time Peter commenced operations, Petersburg was an immense city, and its port was filled with vessels. Large rewards had induced learned men of other nations to make it their residence.

"Whether his ministers were averse to his design, or by whatever other accident it happened, there were at first neither provisions to subsist the workmen, nor wheelbarrows, shovels and other tools to work with. This did but little retard the project; the Czar overlooked it himself, and the dirt was carried in bags, or the skirts of the men's clothes, till they were furnished with better conveniences. The nobility, merchants and tradesmen were ordered to transplant themselves from several parts of the

empire, to erect houses for themselves, and strengthen the new colony. Finland, Carelia, Ingria and Livonia, having lately suffered so much by military execution, saw themselves half depopulated in favor of Petersburg. Those who had knowledge or interest in trade, made great advantages by furnishing the rest with the necessaries of life, which in time became quite abundant, though they still continued dear. In a few years arose 60,000 houses, where in 1702, were only a few miserable huts. As the whole stands partly upon islands, and partly upon the continent, it appears at a distance rather like several distinct towers than a single city. The lowness of the country makes it subject to frequent inundations, by which great losses have been often sustained. The breadth of the river Neva, at Petersburg, is about half a mile, and the current is very deep and rapid; but, where it opens to the bay, the sands render it shallow, which obliges large ships to unload below the town. It was proposed to the Czar to build a bridge of pontoons over this river, (any other bridge being judged impracticable on account of the rapidity of the stream,) but he would not consent to it, because it was his intention to train up as many sailors as possible. A great many passengers at first were drowned before the Russians became dexterous in managing their sails,—and oars were then prohibited,—but they are since allowed to people of fashion, who keep their own watermen, generally four in number.

"There are some handsome stone buildings, palaces and churches in Petersburg. But most of the houses are of wood. The sides consist of square pieces of fir timber, laid one upon another. Turnips, cabbages and cucumbers, are almost the only plants that grow near this city, which is supplied with provisions from Novogrou, Pleshow, Moscow, and even from Casan, 1200 miles distant. Thousands of sleds are perpetually travelling in winter on this route, loaded with corn, flour, fruits and the several products of the respective countries; which, in the summer, are brought by the lakes and rivers. When the boats meet with any accident, everything at once grows excessively dear, noti n Petersburg only, but in

the country around it, which is all furnished by the same channel."

While Peter was so diligently employed in erecting his imperial city, he was also wielding with the same energy the thunderbolts of war. The armies of Sweden and Russia were continually meeting, and the blood of both nations was flowing like water. The soldiers of Charles, in bravery and military skill, were far superior to the soldiers of Peter. But the Czar had almost a boundless empire from which he could replenish his army, and the slaughter of tens of thousands was immediately compensated by the accession of new troops. It is horrible to read the details of those wars, and to behold with what composure the two emperors could look upon the carnage of the battle field. The expenditure of the lives of a few thousand men was a mere trifle. Years rolled on while this deadly war was raging with tremendous fury. Thousands were frozen to death in the winter campaigns. The path of either army might be traced by the blood which the poor soldier left, as with bleeding feet he was hurried over the frozen roads. Oh, who can describe the miseries of war. And yet in this fiend-like employment, men become demons, and every trace of mercy is obliterated from the heart. Attack succeeded attack, and slaughter succeeded slaughter, in uninterrupted continuance. One army after another was swept away, but fresh numbers came to face the cannon's mouth, and to deluge the plains with gore. It was the wicked ambition of Peter which commenced this dreadful war, and his hands were imbrued with the blood of thousands of his fellow beings. How awful must be his condition in that dread day of accounts, when he must stand by the side of the unnumbered soldiers who fell a sacrifice to his ambition. How many miserable orphans, and how many broken hearted widows have had cause for days, months and years to deprecate the memory of Peter.

After many years of contention with various success, Charles made a bold advance into the very heart of the Russian empire. He met the forces of Peter. A bloody battle ensued. Charles was defeated. The Russian army

pressed on the rear of the routed Swedes, and unresisted, cut them down. For many leagues the whole plain was covered with the mangled bodies of the dying and the dead. The shrieks of those in dying agonies swelled far above the uproar of the contending multitude, the clangor of weapons and the thunder of war. This battle was fought early in the morning, and it was a morning of terror, tears and blood. As the sun rose upon the plains of Pultowa, a spectacle was witnessed at which fiends might shudder and angels weep. For many leagues, nothing was to be seen but blood and carnage;—

> "Rider and horse, friend, foe,
> In one red burial blent."

Charles, with difficulty, escaped with his life and fled to Turkey, to solicit aid from the Moslem. For some time there were occasional acts of hostility, but this signal defeat made Peter entirely victorious. The defeat of the Swedes at Pultowa was a great advantage to the empire of Russia. The Swedes were altogether a more enlightened nation than the Russians, and their dispersion through the empire rapidly advanced the knowledge of the arts. About 3,000 officers and 20,000 soldiers were by this victory cut off from all supplies, and at an immense distance from home. They were dispersed all over the dominions of Peter. Wherever they settled, they commenced working at the different trades they were acquainted with, and thus communicated to the people in general, knowledge, which they would not otherwise have so easily attained. Many in the Swedish army were highly educated, and established schools for instruction in languages and mathematics. Thus the ancient inhabitants were rapidly advanced in civilization. Various useful arts, which were well known in Moscow and Petersburg, would have been many years in travelling to the extreme parts of the empire. But by the settlement of the Swedish soldiers these arts were almost universally introduced.

The Czar marched his forces into different provinces of Sweden, and stripped Charles of almost all his territories. He then fought many bloody battles with the Po-

landers. For a time he was also embroiled in contentions with the Turks. His usual intrepidity and energy were manifested in his war with the Moslems, but after marching two thousand miles with an army of 80,000 he was surrounded by ten times the number of Turks, and after several days of desperate fighting was obliged to accede to honorable terms, for permission to march off with his army and baggage. For his preservation at this time he was indebted to the wisdom and prudence of Catharine, and had not the Turks feared that his strength was greater than it really was, his army would inevitably have been destroyed, and himself have been slain or taken captive.

The war with Sweden still continued to linger, Peter not paying much attention to it after the victory of Pultowa, till at last he resolved to bring his enemy to terms. Fitting out a powerful fleet, he sailed along the coast of Sweden, landing at every point, indiscriminately massacreing the inhabitants, and burning and destroying everything in his path. The havoc was dreadful, and Sweden was made an awful spectacle of ruin. The finest towns on the sea coasts were burned, the fields overrun, and the products of the mines cast into the sea. This horrible invasion did but rouse the Swedes to greater fury. At length after twenty years of destructive war, and of untold misery, peace was proclaimed. The result of all this bloodshed and suffering, was to take from Sweden a few provinces, and annex them to the empire of Russia. At the conclusion of peace the senate of Russia passed a resolution, thanking "his majesty for his paternal care and pains in the government of his people, especially during the last war, and entreating him to accept the titles of Peter the Great, father of his country, and emperor of all Russia."

In the year 1723, his health began to fail, but it was not till the middle of January, 1725, that he was obliged to be confined to his chamber. During his sickness he suffered intense agony, and as he himself expressed it, "was convinced what a miserable creature mortal man is." On the 28th of June, 1725, at four o'clock in the morning, he breathed his last. His spirit ascended to the

dread tribunal, and nothing was left on earth of Peter the Great but the cold clay.

The empire he left to the empress Catharine. She had long proved herself worthy of this trust. The affairs of the realm were conducted under her administration with a wisdom which fully justified the Czar in seating her upon the throne.

It is not necessary to say much in conclusion upon his character. From his history it is sufficiently known. We see in it much to admire, and much to deplore. Had his heart been imbued with the religion of Jesus, his astonishing vigor of mind, his undaunted intrepidity, would have made him the benefactor of many, and a curse to none. The time we hope will come, when the great men of the earth, will be great in mercy, and great in goodness; when the sword will be beaten to the ploughshare and the spear to the pruning-hook, and the nations of the earth will learn war no more. From the example of Peter, we may learn what energy and perseverance may accomplish, and we may also take warning from his history, to guard against unhallowed ambition. *He* is the only true benefactor, who is influenced by the christian rule, to do to others as he would that others should do to him.

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THE RIVER NIGER.

Perhaps no locality in the world has been the subject of so much controversy, or occasioned so much excitement or effort, among geographers, travellers and literati generally, as the celebrated river Niger. Its great extent of several thousand miles in length, and its passage through the most beautiful and noble (though almost unknown) countries on the globe, would alone have given it a claim to attention. But it is more particularly owing to the singular circumstance of its source and termination having remained so long undiscovered, that this attention has been augmented to more than usual curiosity, and that a character much the more attractive on account of its mystery, has been attached to that magnificent stream. Some of the theories on this subject, adopted by various learned men or travellers, we shall have occasion to notice, by way of preface to the history which we propose to furnish of the progress and final result of discovery. Most of our readers are no doubt aware, that the work has at length, within a year or two, been completed. The termination of the Niger is laid open, and the discussions and speculations of philosophers, topographers and poets are alike at an end.

The first mention of this river which occurs in history is found in the pages of the Greek writer, Herodotus, who states, in his "Geography of Africa," that some young Nasamonians, a people dwelling in the northern part of that continent, on the borders of the Mediterranean, travelled from Egypt westward, till they came to *a large river*

full of crocodiles, and flowing towards the rising sun; and that they were conducted by the natives to a considerable city situated on its banks. A modern writer, well acquainted with African geography, has not long since expressed his opinion, that this city was no other than what is now known as TOMBUCTOO. The date of the transaction mentioned by Herodotus, is about five hundred years before Christ, and twentythree centuries since.

It is not a little remarkable, that this intelligent and distinguished writer, after all his researches, should have come to the conclusion that the Niger and the Nile of Egypt were one and the same. Pliny entertained a similar opinion. Another ancient geographer, of equal eminence, Mela, while he coincided with the two just named, in placing the source in a part of interior Africa called Lower Mauritania, acknowledgeswith great candor, that when it reaches the centre of the continent, *no one knew what became of it.* Ptolemy, of Egypt, was the first to distinguish between the Nile and the Niger; but his description is so obscure, that it can hardly be determined what course he supposed the latter river to take.

After the dissolution of the Roman empire, when the Arabians, who were an acute and inquisitive people, had gained possession of Northern Africa, a new series of theories commenced. Abulfeda and Edrisi, their most celebrated geographers, instead of allowing the Niger an easterly course, supposed its source to be common with that of the Nile, and gave it the same name; but while the Egyptian river was made to run north into the Mediterranean, "the Nile of the negroes," as the true Niger was called, was allowed a westerly course across the continent, into the Atlantic ocean, or, "Sea of Darkness."

Thus matters continued for some centuries. Europe was unenlightened; navigation lay almost dormant; and no additions, or rather corrections, were made to the Arabian science of the Niger. The Portuguese, a little before the period when America was discovered, were the earliest in a new career of speculation. Intent on carrying on their conquests and trade in India, they were compelled to navigate the coast of Western Africa in their passage round the Cape of Good Hope; and thus, in process of time, several settlements were founded,

from which discovery was extended into the interior. Still, they neither ascertained the source of the Niger, nor even the error of giving it a westerly course,—the truth respecting which we shall soon have occasion to notice.

In the early part of the last century, some of the eminent French geographers entered very zealously into the investigation of this question, but, generally, they followed the Arabian writers, and were as far from the truth. It remained for England to accomplish (though not without many disappointments and much loss of treasure and life,) the grand object which now excited the curiosity of all civilized nations. In the year 1788, a number of wealthy and benevolent individuals in that country, formed themselves into a society for the express purpose of promoting African discovery. Funds were provided; and a reward was offered to the person who should first succeed in ascertaining the course and termination of the Niger.

The first person despatched on this mission, under the auspices of the African association, was JOHN LEDYARD, one of our own countrymen, and a man distinguished by his extraordinary love of travelling, as well as by his courage, hardihood and other good qualities. He had already been round the world with Captain Cook, and had performed a long and most laborious and dangerous journey in Asia, alone and on foot, which stands unrivalled among the exploits of single travellers. He wanted but one virtue, as the sequel will show, and that was *patience*. "He met the proposals of the association with promptness and decision, and departed for Africa in June, 1788. Some idea may be formed of this extraordinary man from his communication to a friend on the morning of his departure:—'I am accustomed,' said he, 'to hardships; I have known both hunger and nakedness to the utmost extremity of human suffering. I have known what it is to have food given me as charity to a madman; and I have at times been obliged to shelter myself under the miseries of that character, to avoid a greater calamity.' Such were the words of Ledyard, and his performances had been no less remarkable. His instructions were to penetrate into Africa by the way of Egypt, and to traverse the continent in the latitude of the Niger. In pur-

suit of this, Ledyard reached Cairo in the month of August following,—where, becoming impatient and vexed by the delay of the caravan with which he was to have travelled, his anxious mind sank under disappointment, and an illness quickly terminated his career."

"In 1795 the celebrated Mr Mungo Park, a native of Scotland, offered his services to the African Association. A knowledge of medicine, besides other useful attainments, added to a natural taste for geographical discovery, peculiarly qualified him for such a purpose; and his offer being accepted, he set out for the Niger. Adopting the route of Major Houghton, he penetrated up the Gambia, and quickly reached Medina. Leaving the Gambia at this place, he kept a more northerly direction, and crossed the Faleme, a tributary to the Senegal, near Fatteconda. Having crossed the Senegal, and passed Kemmoo, he arrived at Jarra, where he found the remains of Major Houghton. On leaving Jarra he adopted a course to the southward of east, and after having experienced great difficulties and privations in consequence of wars, he at length arrived at the long-sought Niger, and beheld it flowing from west to east. From Sego he continued his journey along the bank of the Niger to Silla; where, finding himself exhausted by weakness, and destitute of the means of proceeding farther, he determined on returning to England. He reached the Gambia by a more direct route than that by which he had travelled to the Niger, and arrived in England in December, 1797. At Silla, which he stated as being two hundred miles from Tombuctoo, he collected much information; and thus was the commencement of the Niger first traced on the map from the actual observation of a modern traveller. In this journey Park explored the Niger between Bammakoo and Silla, the former being, according to his account, about ten days' journey distant from its source."

On the return of Park to England, a new theory was suggested in the course of an interview between him and Mr Maxwell, a traveller who was as much interested about the river Congo, as Mr Park was about the Niger. After long consultation together, they concluded that the two streams must be one and the same. Park afterwards acted in pursuance of this opinion; but previously, dis-

coveries were made by Major Rennell. That indefatigable traveller finally adopted the conclusion, that the Niger, after passing the city of Tombuctoo, flowed eastward one thousand miles, and then terminated in a lake or swamp called Wangara. This theory, from an authority so conclusive, was received with great deference.

But the world still doubted and disputed. REICHARD, a German, in particular, though he also believed that the Niger flowed into the Wangara, supposed that it passed *through* that water, flowed subsequently a southwest course, and was received into the Gulf of Guinea. It will be observed hereafter, that Reichard, though he only speculated in a manner which admitted of neither proof nor disproof, was correct in regard to the termination of the river, while he was wholly mistaken in reference to the Wangara.

Another German, named HORNEMANN, was employed by the Association, about the commencement of the present century; but he gained but little information concerning the Niger, and since April, 1800, when he wrote to England that he was on the point of starting for Bornou, nothing has been heard of him. The same remark applies to the traveller, ROENTGEN. But the Association was not discouraged; and but a few years after the death of these persons, a new expedition was ordered, and more vigorous preparations than ever before were made for its success.

"This intelligence was communicated to Park, who, in his usual sanguine manner, eagerly set to work in preparing for the journey. He had drawn up a plan of proceeding, for the accomplishment of which he required the assistance of thirtysix Europeans; six of whom were to be seamen, and the rest soldiers. His plan was adopted, and a sum of five thousand pounds was placed at his disposal by government, for equipping the expedition. The intention of Park was to follow his former track to the Niger, and having reached its banks, there to build two vessels for his party, and to follow with them the course of the river."

It is well known how unfortunately these expectations were blasted.

"The great question of the course of the Niger, which had seemed to be on the dawn of discovery, was again obscured. Much information had been collected concerning the fate of Park and his party, previous to the expedition of the present travellers, by whom it has been confirmed. After experiencing difficulties and dangers of nearly every description, with only seven men remaining of his whole party, and these in such a state, from the effects of the climate, as to be scarcely able to proceed, he at length reached a mountain ridge near Bammagoo, from whence he once more beheld the Niger. Here he considered that all his difficulties were at an end, and proceeded on to Sansanding, on the bank of the river, a few miles below Sego, where he accomplished the building of his vessel. By the time that he was ready to depart, which was on the 17th of November, 1805, when he despatched one of his men, named Isaaco, to England with his journals and letters, five of his party only were left. Among those whom he had lost a few days before was Mr Anderson, his brother-in-law, to whom allusion is made in the following journal.

"The strong determination of Park to persevere in his design of tracing the course of the river to its termination, is thus expressed in one of his letters from this place. 'Though all the Europeans who are with me should die, and though I were myself half dead, I would still persevere, and if I could not succeed in the object of my journey, I would at least die in the Niger.' How truly were his words verified! and yet not by the effect of the climate, which he had wonderfully escaped, but by mere accident, produced by unfortunate circumstances. How often is the cup of hope dashed from our lips, when we consider ourselves most certain of its contents! Intelligence was afterward obtained that Park had reached Boossà, where, being attacked by the natives, as he previously had been in many places after leaving Sansanding, he was driven from his vessel, and perished in the river.

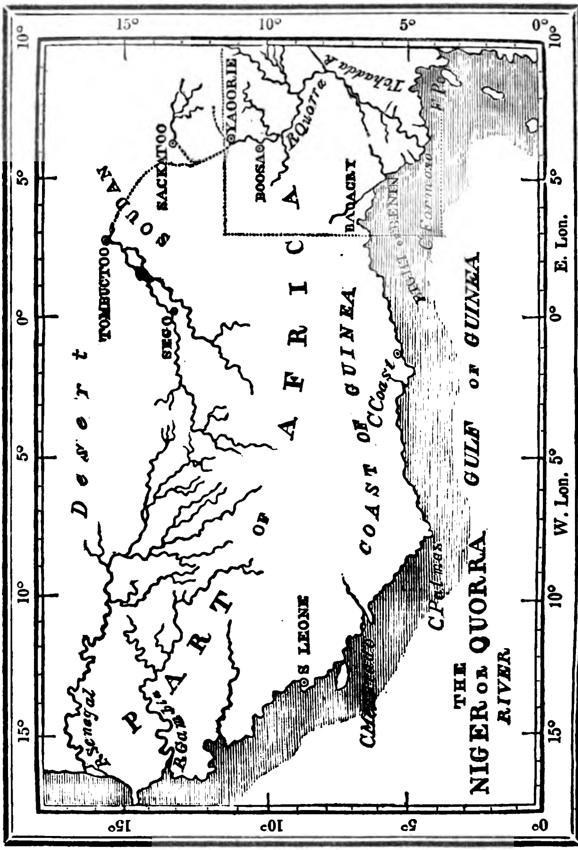
Park is believed to have visited Tombuctoo; and so also did an American sailor, named Adams, not long afterwards, who had been shipwrecked on a part of the African coast, and was taken captive by the wandering Moors. His narrative throws no additional light on the

course of the Niger. Nor does that of Capt. RILEY, in 1815; or of Capt. TUCKEY, who, in 1816, undertook to reach that river by ascending the Congo, and of course did not succeed. Captain CLAPPERTON died in attempting to prosecute the discovery by land, from a point on the western coast. Major LAING met with the same fate, after reaching Tombuctoo, by the way of Tripoli. A Frenchman, named CAILLIE, has since visited that city. But none of these travellers decided the question, and learned and unlearned men still differed as widely as ever. Major DENHAM supposed the termination of the river to be in a large body of water in the interior, called Lake Tshad. Others generally agreed in believing it to flow into the Gulf of Guinea, but differed much in respect to the particular section of the coast where its mouth might be found. Laing ended it in the river Valta, near Accra; Clapperton, near the mouth of the Lagos; Reichard, in the mouth of the river Benin; and others in the mouths of several other streams. The amount of knowledge gained upon the subject, may be inferred from the fact, that the only place known to be situated on the Niger beyond Tombuctoo, was Boossà, the position of which had been declared by Clapperton, while the actual course of the river between the two places still remained wholly unknown.

The traveller just mentioned, in his journal, gives the following amusing summary of the representation made to him by the natives, respecting the course of the river below Boossà.

"Now the great river Cowara comes, and here is its representation. This great river is the largest in all the territories of Haussa; we know not of its source, nor of any one who has seen it. It rushes and precipitates itself through the country from left to right, and contains many islands, inhabited by fishermen, herdsmen, husbandmen, and settlers. As to the variety of its animals, birds and fish, it is only known to the Lord Creator, it has rocks and mountains which break and shatter to pieces all vessels that are driven against them; and its great roaring and noise, with the agitation of its waves, astonish the hearer, and terrify the beholder; and at the same time exhibit the wonderful power of the Omnipotent Creator."

It would certainly be a scarcely less formidable undertaking to attempt comprehending these descriptions, than to explore the river itself to its sources.



Such was the knowledge which the civilized world had acquired of this great river, after all the speculations and exertions of two thousand years, when the idea occurred to the British Government of sending out a new exploring party under the direction of Richard Lander,

who had distinguished himself in the travels of Clapperton on the continent. This young man is descended from parents who live in Cornwall, England. His brother John volunteered to accompany him, and his services were accepted. We shall now proceed to give, very briefly, the result of their labors, sometimes making an abstract, and sometimes using their own language.

They arrived, on the 22d of February, 1830, at Cape Coast Castle, on the coast of Western Africa, in latitude 5° North; whence they soon after passed along the shores of the gulf of Guinea, as far as Accra, another station belonging to the British government. Their point of departure into the interior was Badagry, a populous town governed by a native chief named Adooley, where the travellers engaged several individuals to accompany them as guides and servants. It was the last day of March when they left Badagry, and upon the seventeenth of June they entered Boossa, a large city of huts standing on the banks of the Niger, in latitude about 10° North—the route having been northeasterly from the coast, across mountains, plains, swamps and rivers, partly by land, and partly by boat navigation on the streams. This intermediate territory is in the possession of several distinct and populous tribes, governed by independent kings or chiefs. The inhabitants are barbarous; but instead of being few, wild and wandering, like the North American Indians, they cover the soil in great numbers, and subsist themselves with very little labor upon the various natural productions of one of the most fertile countries on the globe. The following description is given of a large town called Larro, which the travellers reached about a week after leaving the coast.

"The inhabitants possess horses, asses, and mules, though not in any considerable numbers; they have, however, great abundance of sheep and goats, which are bred in the town; and their yards and huts are the common place for resort for these animals — indeed, they may be said to grow up and live with the children of their owners. We have been amusing ourselves during the greater part of today in looking at the playful gambols of some very handsome goats, which had strayed into our abode; but the sheep are not near so tame

or frolicsome, repelling all our advances towards a more familiar acquaintance by timidity and ill-nature. Shrimps and fish, which are caught in the streams in the vicinity of the town, are daily exposed for sale; and the inhabitants appear to be in possession of a greater share of the necessaries and comforts of life than their neighbors of the sea-coast.

"We have observed the country to be sensibly rising to day; and agriculture appears to be conducted on a regular system, which is an evident proof of the active and industrious habits of the people. The gloomy fastnesses and wildnesses of nature, such as we passed on the first day or two of our journey from Badagry, are less common as we advance; and open glades, with plantations of bananas, and fields of yams and Indian corn, all neatly fenced, met our view from the path yesterday and this morning. The inhabitants of Larro also exhibit greater cleanliness of person and tidiness of apparel than the tribes nearer the sea; and importunate beggars have disappeared entirely."

The next considerable place was Jenna, where it is said, "the women employ themselves generally either in spinning cotton or preparing Indian corn for food. Much of the former material grows in the vicinity of the town, but the cultivation of the plant is not carried on with the spirit it deserves. Silk, which is brought over land from Tripoli, the inhabitants sometimes interweave in their cotton garments; but such, being very expensive, are only worn by the higher class of people. They have abundance of bullocks, pigs, goats, sheep, and poultry, but they prefer vegetable food to animal; their diet, indeed, is what we should term poor and watery, consisting chiefly of preparations of the yam and of Indian corn; notwithstanding which a stronger or more athletic race of people is nowhere to be met with. Burdens with them, as with the natives of many parts of the continent, are invariably carried on the head."

We now make an extract from the Journal for April 16th, when the travellers were between Egga and Jadoo. "We found the path in much better condition than those behind it, and it lay almost entirely through plantations of yams, calavances, and pumpkins, and three or four

different varieties of corn, which a number of laborers were employed in weeding, &c. The hoe is the only implement of husbandry in use, and indeed they can well dispense with every other, because the soil during the rainy months is so soft and light that but very little manual exertion in working it is required." The appearance of the country beyond Jadoo resembles a magnificent orchard; and the travellers met on their way hundreds of people of all ages and both sexes, with vast quantities of bullocks, sheep, and goats, as also fowls, which were carried in small wicker baskets on the head. Occasionally they passed over more sterile and less populous tracts, which however were few and far between. A place called Cootoo was one of the kind, but immediately after leaving it the scenery changed.

"The soil was more rich and deeper; patches of verdure and cultivated land were more frequent, the latter being neatly fenced; — fine handsome trees, with their spreading branches and thick foliage, embellished the country in every direction, and extended to the eastern horizon. One would be inclined to suppose that these trees had been carefully planted by the hand of man, for they grew at equal distances from each other, and none seemed to interfere with the order, beauty, and regularity of its neighbor. The soil between them was covered with a soft green turf, which rendered the whole view remarkably pleasant."

Over this delightful landscape the travellers went on in fine spirits. "The morning," say they, "was cooled by a refreshing southeast wind, and we were both on good terms with ourselves and gratified with everything around us. At length we came in sight of numerous herds of fine cattle, attended by little boys, and shortly after we arrived at a clean and neat Falatah village whose inhabitants were employed in feeding calves, and other occupations connected with an African farm. We then crossed a small stream, and entered a town of prodigious extent called Bohoo, which is fortified with a triple moat. Without being exposed to the customary tiresome formalities, we were immediately conducted to the residence of the governor. The usual conversation passed between us, and after we had returned to our hut, a

bullock was sent us, with yams, bananas, and a huge calabash of new milk, which did not contain less than six gallons; and our people sat down to enjoy themselves in perfect good humor."

"Cities" are spoken of in the Journal, but the reader should be reminded that they do not in all respects correspond to what are called cities in civilized countries. They cover an immense area frequently, but the population, though dense, and the elegance and cleanliness, are by no means proportionate to the size. Of the towns in the kingdom of Yariba it is said that a stranger can estimate their size only from the number of courtyards they contain, and that these sometimes accommodate one hundred tenants and sometimes half a dozen.

"Cleanliness and order may contribute to the superiority of one place over another, which may likewise have the advantages of a rich soil, a pleasant neighborhood, and be ornamented with fine spreading and shady trees, but the form of the houses and squares is everywhere the same: irregular and badly built clay walls, ragged-looking thatched roofs, and floors of mud polished with cow-dung, form the habitations of the chief part of the natives of Yarriba, compared to most of which, a common English barn is a palace. The only difference between the residence of a chief and those of his subjects lies in the number and not in the superiority of his court yards, and these are for the most part tenanted by womenand slaves, together with flocks of sheep and goats, and abundance of pigs and poultry mixed together indiscriminately."

As to the character of the natives, it varies according to circumstances, and especially as they have seen more or less of the whites, and of foreign tribes. Some are brave, resolute and warlike, others pusillanimous in the extreme; some detest and despise the white man, others revere him as a superior being able to control the elements themselves. Hence the travellers were very differently received at different places, being frequently cheated, ridiculed, teased and shunned; but on the other hand quite as often welcomed, entertained, caressed and even prayed for, in the most gratifying and affecting manner. At Keeshee, in the kingdom of Borgou, which the travellers left about the last of May, they met with a

company of ladies who visited them to gratify a natural curiosity, which even their extreme diffidence could not suppress. "These females," says the Journal, "are so modest and so retiring, and evince so much native deli cacy in their whole behaviour, that they excited in us the highest respect. Their personal attractions are no less winning. They have fine sparkling jetty eyes, with eye-lashes dark and glossy as the raven's plume. Their features are agreeable although their complexions are tawney. Their general form is elegant, their hands small and delicate; and the peculiar cleanliness of their persons, and neatness of dress added to these, rendered their society altogether as desirable as that of their neighbors was disagreeable."

Quite an acquaintance was formed between the parties, and just as the whites were leaving the place, the ladies came for the last time to bid them farewell. They saluted the Englishmen on bended knees: "Resolved," says Richard L ander, "to have another and a last chat with the white strangers, these females had come for the purpose of offering us two calabashes of new milk. This, and former little acts of kindness, which we have received from these dark-eyed maidens, have effectually won our regard, because we know they were disinterestedly given; and the few minutes which we have had the happiness of spending in their company, and that of their countrymen, have redeemed many hours of listlessness and melancholy, which absence from our native country, and thoughts of home and friends, but too often excite in our breasts. It was therefore not without a feeling of sorrow that we bade them adieu. For my own part, when they blessed me in the name of Alla and their prophet, and implored blessings on my head, and when I gazed upon the faces of the simple-hearted and innocent females who had so piously and fervently invoked the benediction, with the consciousness of beholding them no more in this life, my heart was touched with sorrow; for of all reflections this is certainly the most melancholy and dispiriting!

"'Ye, who have known what 'tis to dote upon
A few dear objects, will in sadness feel:
Such partings break the heart they fondly hoped to heal!'"

The description of a *horse-race*, at a large town called KIAMA, which took place on the 2d of June, will give a better idea than any dissertation possibly could, at once of the scenery, population, manners, customs, amusements, and character of the country and the people.

Immense multitudes were collected together from the neighboring villages. "The race-course was bounded on the north by low granite hills; on the south by a forest; and on the east and west by tall shady trees, among which were habitations of the people. Under the shadow of these magnificent trees the spectators were assembled, and testified their happiness by their noisy mirth and animated gestures. When we arrived the king had not made his appearance on the course; but his absence was fully compensated by the pleasure we derived from watching the anxious and animated countenances of the multitude, and in passing our opinions on the taste of the women in the choice and adjustment of their fanciful and many-colored dresses. The chief's wives and younger children sat near us in a group by themselves; and were distinguished from their companions by their superior dress. Manchester cloths of inferior quality, but of the most showy patterns, and dresses made of common English bed-furniture, were fastened round the waist of several sooty maidens, who, for the sake of fluttering a short hour in the gaze of their countrymen, had sacrificed in clothes the earnings of a twelvemonth's labor. All the women had ornamented their necks with strings of beads, and their wrists with bracelets of various patterns, some made of glass beads some of brass, others of copper, and some again of a mixture of both metals: their ankles also were adorned with different sorts of rings, of neat workmanship.

"The distant sound of drums gave notice of the king's approach, and every eye was immediately directed to the quarter from whence he was expected. The cavalcade shortly appeared, and four horsemen first drew up in front of the chief's house, which was near the centre of the

course, and close to the spot where his wives and children and ourselves were sitting. Several men, bearing on their heads an immense quantity of arrows in huge quivers of leopard's skin came next, followed by two persons, who, by their extraordinary antics and gestures, we concluded to be buffoons. These last two were employed in throwing sticks into the air as they went on, and adroitly catching them in falling, besides performing many whimsical and ridiculous feats. Behind these, and immediately preceding the king, a group of little boys, nearly naked, cam edancing merrily along, flourishing cows' tails over their heads in all directions. The king rode onwards, followed by a number of fine-looking men on handsome steeds; and the motley cavalcade all drew up in front of his house, where they awaited his further orders without dismounting. This we thought was the proper time to give the first salute, so we accordingly fired three rounds, and our example was immediately followed by two soldiers, with muskets, which were made at least a century and a half ago.

"Preparations in the meantime had been going on for the race, and the horses with their riders made their appearance. The men were dressed in caps and loose tobes and trousers of every color: boots of red morocco leather, and turbans of white and blue cotton. The horses were gayly caparisoned: strings of little bells covered their heads; their breasts were ornamented with bright red cloth and tassels of silk and cotton; a large quilted pad of neat embroidered patchwork was placed under the saddle of each; and little charms, inclosed in red and yellow cloth, were attached to the bridle with bits of tinsel. The Arab saddle and stirrup were in common use; and the whole group presented an imposing appearance.

"The signal for starting was made, and the impatient animals sprang forward and set off at a full gallop. The riders brandished their spears, the little boys flourished their cows' tails, the buffoons performed their antics, muskets were discharged, and the chief himself, mounted on the finest horse on the ground watched the progress of the race, while tears of delight were starting

from his eyes. The sun shone gloriously on the tobes of green, white, yellow, blue, and crimson, as they fluttered in the breeze; and with the fanciful caps, the glittering spears, the jingling of the horses' bells, the animated looks and warlike bearing of their riders, presented one of the most extraordinary and pleasing sights that we have ever witnessed. The race was well contested, and terminated only by the horses being fatigued and out of breath; but though every one was emulous to outstrip his companion, honor and fame were the only reward of competitors.

"A few naked boys, on ponies without saddles, then rode over the course, after which the second and last heat commenced. This was not by any means so good as the first, owing to the greater anxiety which the horsemen evinced to display their skill in the use of the spear and the management of their animals. The king maintained his seat on horseback during these amusements, without even once dismounting to converse with his wives and children, who were sitting on the ground on each side of him. His dress was showy rather than rich, consisting of a red cap, enveloped in the large folds of a white muslin turban; two under tobes of blue and scarlet cloth, and an outer one of white muslin; red trousers, and boots of scarlet and yellow leather. His horse seemed distressed by the weight of his rider and the various ornaments and trappings with which his head, breast, and body were bedecked. The chief's eldest and youngest sons were near his women and other children, mounted on two noble looking horses. The eldest of these youths was about eleven years of age. The youngest, being not more than three, was held on the back of his animal by a male attendant, as he was unable to sit upright in the saddle without this assistance. The child's dress was ill suited to his age. He wore on his head a tight cap of Manchester cotton, but it overhung the upper part of his face, and together with its ends, which flapped over each cheek, hid nearly the whole of his countenance from view; his tobe and trousers were made exactly in the same fashion as those of a man, and two large belts of blue cotton, which cross-

ed each other, confined the tobe to his body. The little legs of the child were swallowed up in clumsy yellow boots, big enough for his father; and though he was rather pretty, his whimsical dress gave him altogether so odd an appearance that he might have been taken for anything but what he really was. A few of the women on the ground by the side of the king wore large white dresses, which covered their persons like a winding sheet. Young virgins, according to custom, appeared in a state of nudity; many of them had wild flowers stuck behind their ears, and strings of beads, &c, round their loins; but want of clothing did not seem to damp their pleasure in the entertainment, for they appeared to enter into it with as much zest as any of their companions. Of the different colored tobes worn by the men, none looked so well as those of a deep crimson color on some of the horsemen; but the clean white tobes of the Mohammedan priests, of whom not less than a hundred were present on the occasion, were extremely neat and becoming. The sport terminated without the slightest accident, and the king's dismounting was a signal for the people to disperse."

After reaching the Niger at Boossà, as we have already mentioned, considerable time was spent in ascending it some hundred miles towards Tombuctoo; but after reaching Yaoorie, about the last of June, the travellers commenced their return-voyage, and continued it at intervals to the mouth of the river, which they reached late in the fall. All below Yaoorie, then, to the Gulf of Guinea, where the Niger is at last ascertained to empty, has been explored. The distance between that place and Tombuctoo is the only unvisited part of its course; and its continuity between those two points is established by a number of facts which may be considered wholly conclusive.

The discoveries made by the Landers during this memorable journey and voyage, cannot but prove as important as they are interesting to the world. At present we know no good reason to doubt, that the Niger may be ascended and descended by European craft, for thousands of miles, with as much ease and safety as our great river

Missouri recently has been mounted by a *steam-boat*, from St Louis to the mouth of the Yellow-Stone. This kind of navigation will probably be found much the most suitable to the Niger; and indeed a large and convenient boat has already been built on the Thames at London, at the charge of the British government, and under the inspection of the Landers, for the express purpose of trying the experiment. The travellers will return by this conveyance to the scene of their discoveries, ascend and accurately survey as much of the river as possible, and perhaps make some arrangements with the native potentates for a permanent and mutual commerce between them and the English.

The materials for such a commerce will be found, on the one hand, in all those articles, manufactured and others, which the Africans need and covet, and which the English can easily supply. Various descriptions of cloths and cutlery are among the number. It may be expected, indeed, that even those imperfect manufactures which the Africans exercise at present, will be abandoned in some degree, whenever they shall see themselves accommodated with much better and handsomer articles of the same kind, as well as others—by foreigners—at low rates—and in barter for commodities which *they*, on the other hand, can produce in the greatest abundance almost without effort, and spare without feeling the loss. This is particularly true of the fruits of the soil, including the most useful grains; nor does there seem to be any good reason why Central Africa should not be the granary of England, in all cases of emergency at least, as Sicily and Northern Africa were anciently the granary and the vineyard of Rome.

Cotton also belongs to the soil, and may probably be raised in unlimited quantities. Coffee is a native in some districts; and indigo and rice in almost all. The sugar-cane also thrives. The fruits and roots are numerous, and of the most nutritious and luscious kinds. Among them are not only the sweet potato, cassada, yam, &c, which the natives generally use for daily food, but the cocoa-nut, orange, lemon, the pine-apple occasionally, and many others. When to these we add vari-

ous species of spices, gums, perfumes, dyes, ivory, gold, with all the curiosities and rarities, vegetable, animal and mineral, which belong to a rich tropical country, it will be at once perceived that the prospect could hardly be more encouraging in a mercantile point of view than it is.

It should be observed, furthermore, that the Africans are the most *trading* people, in propensity and in pursuit, on the face of the globe, — not excepting the Yankees themselves. The people everywhere crowd together in cities, that they may trade together. Great markets are maintained: in some cases weekly, and in others daily; and these are regularly attended by immense multitudes from the surrounding country, of both sexes and all sizes and classes, who come by land or water from a distance of several miles, and bring their cowries* and their commodities with them. Every African is in fact a merchant. If he cannot deal in slaves, as too many of them are barbarous enough to do, he must trade in salt, grain, ivory, poultry, or other domestic animals—almost all kinds of which, we might have remarked before—including horses, asses, mules, sheep, swine, goats, and kine—cover the whole country in prodigious numbers. Wool, of course, though it is not now used, may become a staple of prime consequence.

Nor ought it to be forgotten that the Africans, and especially those of the new-found kingdoms of the Niger, are in general very well disposed towards white men. Among some of the natives there is a violent prejudice against them all, indiscriminately, much stronger than any which exists against the blacks in any civilized country. And it must be allowed, there has been but two frequent and too flagrant cause for such a feeling; especially in the long-continued and horrible enormities of the slave-trade. But England and the United States, with some other Powers, have abandoned the traffic, and commenced a course of just restitution and reparation for the wrongs heretofore inflicted upon this ill-fated Con-

* A small shell, used as a coin of trifling value, and exactly corresponding to the *wampum*, or wampum-peague, of the American Indians.

tinent; and although it may take some time and some trouble to remove the impression already made (so far as *they* are concerned) from the minds of those who have seen and suffered the influence of the traffic, there is in the case of the Niger tribes at least *no* impression about the matter. At least, there is none very unfavorable to the white men generally, the worst of whose conduct on the coast they have not only never seen or suffered, but never heard of. They regard them simply as a trafficking and sociable people like themselves, bent upon making money, and willing to labor hard for that purpose. To this they indeed add in most cases a peculiar feeling of respect, amounting sometimes to reverence, founded on the great and to them unaccountable superiority of foreigners, whose *civilization* they do not yet comprehend. In a word, they are in the best possible state to be conciliated and gained over to an attachment which ought to prove as profitable and agreeable to themselves, in every sense, as it possibly could to any foreign parties.

We now allude more particularly to the final effects, which may be rationally anticipated, in this quarter of the earth, from a lawful and honorable acquaintance and commerce with other nations. If pains are taken to gain their confidence, they will willingly receive instruction in the arts and in religion. If a proper example is set before them by those Europeans and Americans who will or may soon go among them, and perhaps live with them, in considerable numbers, they will take a pride in imitating the habits of civilized men; and thus, in the most usual, natural, and almost unavoidable course of things, will themselves become gradually civilized, precisely as children copy after the manners, customs, and language of those around them in early life. A sound and well-regulated commerce — not a peddling or privateering or piratical one, — will promote the same end, going hand in hand with association, example and instruction, by inducing the natives to adopt habits of industry, and especially of agricultural industry, to enable them to meet those advances of foreign trade by which they will no doubt be as much delighted as profited.

It is unnecessary to add, that the civilization of Africa

itself is the best, and indeed only means to be relied upon for the suppression of the slave-trade. If they were not themselves ignorant, abject, undisciplined, and unarmed in some cases, they would not be *kidnapped*. If they were not equally barbarous in their customs and feelings, they would not kidnap, or capture, or sell each other. Thus the two great sources of the slave-trade would be forever sealed. Vice would be reformed, and force would be resisted.

We shall conclude this notice of the Niger with a sketch of the principal cities discovered by the Landers on its banks, between Yaoorie and the sea. Yaoorie itself they describe as "a large, flourishing, and united kingdom. It is bounded on the east by Haussa, on the west by Borgoo, on the north by Cubbie, and on the south by the kingdom of Nouffie. The crown is hereditary, and the government an absolute despotism. The former sultan was deposed by his subjects for his violent measures and general bad conduct; and the present ruler, who succeeded him, has reigned for the long period of thirtynine years. The sultan has a strong military force, which has successfully repelled, it is said, the repeated attacks which the ever-restless Falatahs for a number of years past made on the city and kingdom of Yaoorie; it is now employed in a remote province in quelling a rising insurrection, occasioned partly from the inability of the natives to pay their accustomed tribute, and partly from the harsh measures adopted by the sultan to compel them to do so. The city of Yaoorie is of prodigious extent, and is supposed to be as populous as any other in the whole continent, or at least that part of it which is visited by the trading Arabs. Its wall is high and very excellent, though made of clay alone, and may be between twenty and thirty miles in circuit; and it has eight vast entrance-gates or doors, which are well fortified after the manner of the country. The inhabitants manufacture a very coarse and inferior sort of gunpowder, which, however, is the best, and, we believe, the only manufactory of the kind in this part of the country; besides which, they make very neat saddles, country cloth, &c; and they grow indigo, tobacco, onions, wheat, and

different kinds of grain, and vast quantities of rice of superior quality. The inhabitants have likewise horses, bullocks, goats, &c, but notwithstanding their industry and the advantages which they enjoy, they are very poorly clad, have little money, and are perpetually complaining of their bad condition. An indifferent market is held in the city daily under commodious sheds, in which the above articles are offered for sale.

"The sultan's residence, as well as the houses of many of the principal inhabitants of the city, are two stories in height, having thick and clumsy stairs of clay leading to the upper apartments, which are rather lofty; and, together with rooms on the ground-floor, have doorways sufficiently large to enable a person to enter them without putting himself to the inconvenience of stooping. The principal part of the houses are built in the circular or coozie fashion, but the inhabitants have a few square ones; and the sultan's are of no regular form whatever. It may be considered somewhat singular that the generality of the natives Western and Central, and, we believe, also of Northern Africa, 'moisten the floors of their huts and the inside of their walls with a solution of cow-dung and water, two or three times a day, or as often as they can find the materials.' 'Though disagreeable to the smell of a European, this keeps the interior of a dwelling as cool as it is dark.' We should have thought that Dr Johnson, from whom this quotation is taken, was speaking of the native dwellings of this part of the world, instead of those of the East Indies, so exactly does he describe them." * *

The city of Boossà consists of a great number of groups or clusters of huts, all within a short distance of each other. It is bounded on one side by the river Quorra or Niger, and on the other by an extensive turreted wall, with moats, forming a complete semicircle. Notwithstanding, however, its natural and artificial defences, Boossà was taken by the Falatahs many years ago; on which occasion its inhabitants fled, with their children and effects, to one of those little islands in the Niger which we have already mentioned. But the chiefs of Niki, Wowow, and Kiama, having been made acquainted with the cir-

cumstance, assembled together, and having joined their forces with those of Boossà, drove the Falatahs, their common enemy, into the Niger, where many of them perished. Since that period the city has never been invaded, nor threatened with attack. The soil of Boossà is, for the most part, very fertile, and produces rice, corn, yams, &c, in great abundance.

The Falatahs, so often mentioned by the Landers, are an African people, but they do not belong originally to this section of the continent. On the contrary, migratory like the Arabs, and like many other people in various parts of the world, they have wandered from place to place, until they have at length reached the country of the Niger, and mingled themselves with the tribes on its borders. In some cases they constitute a majority of the population. Generally they have more than their share of influence and power, being a warlike and restless people. It seems to be their ambition, as the Landers believe, to arrive finally at the Western coast, towards which indeed they have been constantly though slowly advancing for a long period of time.

The following account of a town called Bajiebo is is given in the Journal, — one of the largest and most populous places which the travellers visited.

"A considerable traffic is carried on by its inhabitants with their countrymen on the opposite side of the river, for which purpose they have a great number of canoes of large dimensions, which are continually employed every day in crossing from side to side. Their huts are erected so close to each other, and with so little regard to comfort and a free circulation of air, that there is scarcely a footpath in the town wide enough for more than one man to walk on at a time; and not having the advantage of shady trees, the heat of the town is excessive and distressing. Its uncleanness, filth, and extreme nastiness have already been alluded to; and the odor emitted from the dirty streets is offensive and almost insupportable. The people formerly inhabited a town on the opposite bank of the Niger, but as was the case with those of Layaba, they were induced, or rather compelled to settle here, on account of the commotions occasioned

by the civil wars, and like them, too, they have been found out by their greatest enemies." * * *

"*Egga* is of prodigious extent, and has an immense population. Like many other towns on the banks of the river, it is not unfrequently inundated, and a large portion of it, as at the present moment, actually overflowed. No doubt the people have their reasons for building their habitations in places which appear to us so very inconvenient and uncomfortable. The soil in the vicinity of the town consists of a dark heavy mould, uncommonly fruitful, and produces in abundance and with trifling labor all the necessaries of life, so that provisions are plentiful and cheap. The inhabitants eat little animal food besides fish, which are likewise sold at a very reasonable rate. Hyenas are said to abound in the woods in incredible numbers, and they are so bold and rapacious as to have carried away nearly the whole of the sheep which were once in the town. Perhaps Egga can boast of having a greater number of canoes, both large and small, than any single town to the northward."

SCIENTIFIC TRACTS.

VOL. II......NO. XXI.

AFRICAN SLAVE TRADE.

In the following pages we propose to furnish a brief account of the African Slave-trade; and we shall separ ately consider its sources and modes of operation, its extent, its consequences, its history and the history of legislation respecting it, and finally, the remedies which have been or may be applied for the suppression of what at the present day it needs no argument to prove, and no apology to pronounce, an outrageous and enormous evil.

We regard the subject as more peculiarly interesting under present circumstances, inasmuch as the coast of Western Africa, which is chiefly the theatre of this horrible trade, has recently been the object of very important and anxious inquiry, discovery and discussion. The world would gladly be informed, to what singular fatality, so to speak, in the situation of the country or the character of the people, this horrible curse can be ascribed which seems to have fastened itself for ages upon one section of the globe; how much of the evil, on the other hand, is their misfortune merely, and the crime of foreign nations; what are the effects of the trade alike upon its instigators, instruments, and victims; and above all, what may be done, under the circumstances, most effectually to terminate a practice which has so long desolated the human race upon one side and disgraced and degraded it upon the other.

The primary if not principal source of the slave-trade is to be found in the immemorial customs and habits of the natives. Western Africa, like most other parts of that continent, is in the possession, very generally, of a large number of petty chiefs — or, as they affect to consider

themselves, kings—each of whom holds absolute dominion over his own territory and people. These are of various numbers and extent; and indeed so various, that no observation in regard to the power or population of one despot or district can be presumed to apply to that of any other. Some of them may be compared to the Indian tribes upon this continent, and this is especially true of those rugged and sterile sections of the country, where the subsistence is more difficult, and the inhabitants more hardy and less numerous. But this description does not frequently apply. The soil is for the most part one of the most luxuriously fertile on the face of the globe, supplying, almost without effort on the part of man, all the materials of good living in the most inexhaustible abundance. The streams are full of fish. The forests are crowded with wild game. The lakes and ponds are covered with waterfowl. Every species of domestic animal, of much value, known in *this* quarter of the earth, is found there, swarming in vast numbers. Indigo, cotton, millet, sugar cane, coffee, corn, cassia, ginger, cinnamon, pepper, pineapples, oranges, limes, bananas, plantains, yams, cassada, sweet potatoes, ground-nuts, palm wine and oil, are all readily produced, or rather gathered without culture, in every direction. Add to this, that the climate is genial and delicious, so that the inhabitants require neither shelter nor clothing the year round, and it will readily be conceived what a contrast there is, and well may be, in regard to population, as well in many other matters dependent on external circumstances, between these Africans and the natives of our own stern and rock-bound shores.

A few facts will make this comparison more distinct. The Indian tribes scarcely ever exceed a very few thousand at the utmost, and a few hundred is the average number.

Now let us turn our attention to DAHOMEY, a state on that part of the Southern shore of the gulf of Guinea which is called the slave-coast, and which was the first large district of Western Africa ever visited by Europeans. In 1772, an Englishman, named Norris, penetrated into the interior about 150 miles, as far as ABOMEY, the capital.

It need only be said of this people, that their king, who is one of the most absolute despots on earth, keeps very little fewer than 3000 wives, who serve him in various capacities, being regularly regimented to act as body-guards, and equipped with drums, flags, bows and arrows, and occasionally a few muskets. All these reside in the "palace," — an immense assemblage of cane and mud huts, enclosed by a high wall.

The Southern FOULAHS were visited, in 1794, by two enterprising Englishmen, who ascended the Rio Nunez. These natives manufacture sugar to such an extent, that caravans of 500 were often met, carrying loads of 160 pounds on their heads. The two principal towns, LABY and TEEMBO, were estimated to contain respectively 5000 and 7000 inhabitants. The king could muster 16,000 troops, whom he was in the habit of employing almost continually to wage war upon, or rather to hunt down, about twenty small neighboring tribes, *chiefly with the view of procuring slaves to sell on the coast.*

Dahomey lies in about the same latitude with the English colony of Sierra Leone, about 9° north. Between the two is ASHANTEE, a nation much distinguished within a few years by the trouble they have given the English on the coast. Until about 30 years since, the Ashantees were an inland people, being separated from the ocean by AQUAMBOC, DIRKIRA and other considerable states. But the latter gave some offence, and the Ashantee King, therefore, in 1808, sent an army of 15,000 warriors to ravage and lay waste everything in their way. The FANTEES met the invaders with 9000 men. But in vain: they were routed, and most of them put to death. A few escaped to a British station on the coast, and were sheltered from their pursuers. The Ashantees attacked the fort, but although the garrison numbered but twelve, the barbarous and undisciplined assailants were repulsed with considerable loss. They were struck with astonishment and admiration at such bravery. Proposals of peace were made and accepted; a treaty was negotiated; and several visits took place between the parties. A number of Englishmen explored the Ashantee country

in 1817, when they ascertained, on good authority, that the King had lately sacrificed on the grave of his mother 3000 victims, 2000 of them being Fantee prisoners or slaves; and that upon the death of the late sovereign, a sacrifice of 200 slaves at a time had been continued weekly for three months.

These facts illustrate, better than any dissertation could do, both the extent of population and the character of government in the countries under consideration. It seems, that the rank of the deceased in the future world is thought to be decided by the train which he carries with him from this. The son and successor, from filial affection, adds as many as possible to the number of victims; and the courtiers and guards seek to please him by the most arbitrary and violent exertions to the same end. The Dahoman king sends *messages* to the other world by captives, who are executed on the spot, that they may have the honor of serving him. Such is the extreme superstition of all classes, and such the abject subordination, or rather servitude of the people.— To finish our sketch of the Ashantees, the British authorities on the coast became engaged in a war with them, in 1824, by rather rashly undertaking to assist the Fantees in throwing off the Ashantee yoke. The latter entered the Fantee country with 15,000 men. A battle ensued between them and the combined allies. The latter, owing chiefly to the cowardly conduct of the Fantees, were defeated; and the English lost a large number of men, including their commander, Governor McCartney, who was beheaded by the enemy on the field. A peace has since been concluded, and the colonies have experienced no further trouble from the natives.

Since the date of these transactions, Captain Adams, an Englishman, in the course of a trading-voyage along the shore, has visited Benin, a country lying east of Dahomey and Ashantee, and like them upon the north of the gulf of Guinea, and in the same latitude with Sierra Leone. The capital of this kingdom is said to contain 15,000 inhabitants.

Here it is that the celebrated Niger has recently been found to pour its vast tide into the Atlantic Ocean. That

river runs from the north, in a uniform direction, something like a thousand miles, previous to its termination ; and nearly all this distance was explored during the recent journey and voyage of the Landers. Those travellers repeatedly describe towns and cities of immense extent, the population of which must be greater than that of any yet mentioned, while that of the surrounding country is in quite equal proportion. The same remark is true of much of that portion of Western Africa, in the latitude of the river Gambia, (about 12° north,) which Mungo Park travelled over about the close of the last century.

Still another section of the coast is now owned, and to a considerable degree occupied, by the settlements and stations of the American Colonization Society. They have at various times succeeded in purchasing of the different chiefs, who were or professed to be proprietors, an extent of nearly 300 miles along the African shore, mostly between the latitudes of 4° and 7° north, and not far south of the Colony of Sierra Leone. This tract, called Liberia, extends inward from 20 to 30 miles generally, but in some places to an indefinite breadth. At the distance just named a belt of dense forest, a day's journey in width, and running nearly parallel with the coast, has hitherto sufficed to prevent intercourse between the interior and maritime tribes. No doubt the former will soon be better known. The latter, within the Liberian jurisdiction, comprise, 1. The Feys, or Deys, who, to the number of 12 or 15,000, occupy about 50 miles in length. 2. The Deys, from 6 to 8,000, with a territory of 30 miles; a people as indolent and inoffensive as the former are active and warlike. 3. The Bassa tribes, with a population estimated at 125,000; mostly industrious and peaceable, and whose country, abounding in rice, oil and cattle, rivals in fertility any upon the African coast.

We have now given a statistical account, though far from a minute one, of nearly the whole of what is properly called Western Africa, according to the present state of our information. It is a country which, independently of its connexion with foreign colonies, or its vast resources for commerce, deserves and needs to be better known

than it has been, as the grand arena of the slave-trade. Let us next consider more particularly the circumstances explanatory of that practice.

In the first place, then, it should be understood, that SLAVERY is not only a custom, but an exceedingly prevalent and quite ancient one, over the whole surface of the African continent. The account given by Mungo Park of the sources and supplies of it, was founded on extensive observations in the western section, and with few variations may be considered applicable, as he himself applies it, to Africa at large.

He divides all slaves into two classes: *first*, such as are in that condition from their birth; and *secondly*, such as were born free. As all of course who do not belong to the former class, are yet descended from them, the distinction is a matter of little importance in the discussion of the origin and occasions of the custom. It may be observed, however, that the difference to the slaves themselves, respectively, is quite important. By long custom, which has acquired the force of law, *domestic* slaves, or those who are born in a man's own house, are treated with peculiar lenity. His authority over them extends only to reasonable correction. He cannot sell them, without giving them a public trial for the cause alleged, unless it become necessary for the purchase of provisions during famine; though they are liable to be seized on by creditors, and sold to discharge debts like *property* "attached," in most civilized countries.

All other than domestic slaves are considered, politically and personally, as strangers and foreigners, and may be treated or disposed of according to the owner's pleasure. There are regular markets, where they are bought and sold, several instances of which are mentioned not only by Park, but by the Landers, and by most other travellers on the continent. Their value in English money varies at different times and places. Mr Park sets it between fifteen and twentyfive pounds, probably not far from $100, at the mouth of the Gambia, in 1799. In the interior they are more commonly made an article of barter; and their value depends somewhat on the distance from their native kingdom, as upon that circum-

stance chiefly depends the chance which the slave has of escaping. Those sold on the coast, and conveyed thither by regular slave-merchants (whom Park calls *slatees,*) from stage to stage, are mostly of a class who have been transferred from one hand to another until the distance from home makes their situation altogether desperate.

As a single anecdote will illustrate the character and custom of the slave-merchants, and the condition of the poor slaves, better than all we could say in general terms, we shall extract an interesting passage from the Journal of Park. It occurs on his route from the interior to the coast, where he had connected himself with a regular *caravan*, for the sake of security in travelling.

"About eleven o'clock, as we were resting by a small rivulet, some of the people discovered a hive of bees in a hollow tree, and they were proceeding to obtain the honey, when the largest swarm I ever beheld, flew out, and attacking the people of the coffle, made us fly in all directions. I took the alarm first, and I believe was the only person who escaped with impunity. When our enemies thought fit to desist from pursuing us, and every person was employed in picking out the strings he had received, it was discovered that the poor woman abovementioned, whose name was Nealee, was not come up, and as many of the slaves in their retreat had left their bundles behind them, it became necessary for some persons to return and bring them. In order to do this with safety, fire was set to the grass a considerable way to the eastward of the hive, and the wind driving the fire furiously along, the party pushed through the smoke, and recovered the bundles. They likewise brought with them poor Nealee, whom they found lying by the rivulet. She was very much exhausted, and had crept to the stream, in hopes to defend herself from the bees by throwing water over her body; but this proved ineffectual, for she was stung in the most dreadful manner.

"When the Slatees had picked out the stings as far as they could, she was washed with water, and then rubbed with bruised leaves; but the wretched woman obstinately refused to proceed any farther, declaring that she would rather die than walk another step. As entreaties

and threats were used in vain, the whip was at length applied, and after bearing patiently a few strokes, she started up and walked with tolerable expedition for four or five hours longer, when she made an attempt to run away from the coffle, but was so very weak, that she fell down in the grass. Though she was unable to rise, the whip was a second time applied, but without effect; upon which Karfa desired two of the Slatees to place her upon the ass which carried our dry provisions; but she could not sit erect, and the ass being very refractory, it was found impossible to carry her forward in that manner. The Slatees however were unwilling to abandon her, the day's journey being nearly ended; they therefore made a sort of litter of bamboo canes, upon which she was placed, and tied on it with slips of bark; this litter was carried upon the heads of two slaves, one walking before the other, and they were followed by two others who relieved them occasionally. In this manner the woman was carried forward until it was dark, when we reached a stream of water at the foot of a high hill, called Gankaran-Kooro, and here we stopt for the night, and set about preparing our supper. As we had only eat one handful of meal since the preceding night, and travelled all day in a hot sun, many of the slaves who had loads upon their heads, were very much fatigued, and some of them *snapt their fingers*, which among the negroes is a sure sign of desperation. The Slatees immediately put them in irons, and such of them as had evinced signs of great despondency, were kept apart from the rest, and had their hands tied. In the morning they were found greatly recovered.

"*April* 25*th*. At daybreak poor Nealee was awakened, but her limbs were now become so stiff and painful, that she could neither walk nor stand; she was therefore lifted like a corpse upon the back of the ass, and the Slatees endeavored to secure her in that situation, by fastening her hands together under the ass's neck, and her feet under the belly, with long slips of bark; but the ass was so very unruly, that no sort of treatment could induce him to proceed with his load, and as Nealee made no exertion to prevent herself from falling, she was

quickly thrown off and had one of her legs much bruised. Every attempt to carry her forward being thus found ineffectual, the general cry of the coffle was, *kang-tegi, kang-tegi*, 'cut her throat, cut her throat;' an operation I did not wish to see performed, and therefore marched onwards with the foremost of the coffle."

The degree of subordination to which these unfortunate creatures are soon reduced by suffering, discipline and despair, appears in the following paragraph from the same authority with the above:

"About eleven o'clock, to our great joy and surprise, the freeman and slaves who had parted from the coffle the preceding night, entered the town. One of the slaves it seems, had hurt his foot, and the night being very dark, they soon lost sight of the coffle. The freeman, as soon as he found himself alone with the slaves, was aware of his own danger, and insisted on putting them in irons. The slaves were at first rather unwilling to submit, but when he threatened to stab them one by one with his spear, they made no further resistance, and he remained with them among the bushes until morning, when he let them out of irons, and came to the town in hopes of hearing which route the coffle had taken."

It should not be understood that the Slatees are altogether unfeeling or unprincipled men. Slavery is an ancient custom, on which they have learned to look with forbearance in the first instance, and without emotion of any kind in the last. They deal in slaves with the same feeling as in salt, ivory or gold dust. At a place near the coast, called Baniserile, the following incident is recorded by Park:

"One of our Slatees was a native of this place, from which he had been absent three years. This man invited me to go with him to his house, at the gate of which his friends met him, with many expressions of joy, shaking hands with him, embracing him, and singing and dancing before him. As soon as he had seated himself upon a mat by the threshold of his door, a young woman, his intended bride, brought a little water in a calabash, and kneeling down before him, desired him to wash his hands; when he had done this, the girl, with a tear of

joy sparkling in her eyes, drank the water, this being considered as the greatest proof she could possibly give him of her fidelity and attachment. About eight o'clock the same evening, the Serawoolli, who had been left in the woods to take care of the fatigued slave, returned and told us that he was dead; the general opinion however, was, that he himself had killed him, or left him to perish on the road; for the Serawoollies are said to be infinitely more cruel in their treatment of slaves than the Mandingoes. We remained at Baniserile two days, in order to purchase native iron, shea butter, and some other articles for sale on the Gambia; and here, the Slatee who had invited me to his house, and who possessed three slaves, part of the coffle, having obtained information that the price on the coast was very low, determined to separate from us and remain with his slaves where he was, until an opportunity should offer of disposing of them to advantage, giving us to understand, that he should complete his nuptials with the young woman before mentioned, in the meantime."

We shall make one more extract from this valuable work, showing the manner in which these negroes were treated at the commencement of the expedition to the mouth of the Gambia.

"A deeply rooted idea, that the whites purchase negroes for the purpose of devouring them, or of selling them to others that they may be devoured hereafter, naturally makes the slaves contemplate a journey towards the coast with great terror; insomuch, that the Slatees are forced to keep them constantly in irons, and watch them very closely, to prevent their escape. They are commonly secured by putting the right leg of one and the left of another into the same pair of fetters. By supporting the fetters with a string they can walk, though very slowly, every four slaves are likewise fastened together by the necks, with a strong rope of twisted thongs; and in the night, an additional pair of fetters is put on their hands, and sometimes a light iron chain passed round their necks.

"Such of them as evince marks of discontent are secured in a different manner. A thick billet of wood is

cut about three feet long, and a smooth notch being made upon one side of it, the ankle of the slave is bolted to the smooth part by means of a strong iron staple, one prong of which passes on each side of the ankle. All these fetters and bolts are made from native iron; in the present case they were put on by the blacksmith, as soon as the slaves arrived from Kancaba, and were not taken off until the morning on which the coffle departed for Gambia.

"In other respects, the treatment of the slaves during their stay at Kamalia, was far from being harsh or cruel. They were led out in their fetters every morning to the shade of the tamarind tree, where they were encouraged to play at games of hazard, and sing diverting songs to keep up their spirits; for though some of them sustained the hardships of their situation with amazing fortitude, the greater part were very much dejected, and would sit all day in a sort of sullen melancholy, with their eyes fixed upon the ground. In the evening their irons were examined, and their hand fetters put on; after which they were conducted into two large huts, where they were guarded during the night by Karfa's domestic slaves. But notwithstanding all this, about a week after their arrival, one of the slaves had the address to procure a small knife, with which he opened the rings of his fetters, cut the rope, and made his escape; more of them would probably have got off had they assisted each other; but the slave no sooner found himself at liberty, than he refused to stop, and assist in breaking the chain which was fastened round the necks of his companions."

The immediate causes or occasions of slavery in Africa may be comprised under four heads, viz. captivity, famine, insolvency, and crime.

In the first place, a freeman may, by custom established throughout Africa, become a slave by being taken in war, and this Mr Park believed to be far the most productive source, if not the origin of the system. Population, as we have shown, is exceedingly abundant; wars of some kind or other are almost perpetual; the arms of the natives are far from destructive: and the consequence of all these circumstances is, that large numbers

of prisoners are frequently taken. In some instances they are slain, for sacrifice or in the heat of revenge; and the more troublesome prisoners are the first to be despatched from mere apprehension of the trouble they may seem disposed to give. But, generally, the Africans do not sacrifice largely, and they are not naturally a bloodthirsty people. On the other hand, they would find it extremely inconvenient to maintain their prisoners. The result is, that they are compelled to labor, at first for their own subsistence, and afterwards for that of their masters. It should be added, that these wars are frequently undertaken on the most frivolous pretences: and there cannot be the least doubt that the market which foreigners have maintained for slaves on the coast, has in numberless instances prompted the petty chieftains of the interior to worry and devour each other in the hope of making money by the prisoners. "In many cases," says Park, "no immediate cause of hostility is assigned, or notice of attack given; but the inhabitants of each, watch every opportunity to plunder and distress the objects of their animosity by predatory excursions. These are very common, particularly about the beginning of the dry season, when the labor of the harvest is over and provisions are plentiful. Schemes of vengeance are then meditated. The chief man surveys the number and activity of his vassals, as they brandish their spears at festivals, and elated with his own importance, turns his whole thoughts towards revenging some depredation or insult, which either he or his ancestors may have received from a neighboring state. Wars of this description are generally conducted with great secrecy. A few resolute individuals, headed by some person of enterprise and courage, march quietly through the woods, surprise in the night some unprotected village, and carry off the inhabitants and their effects, before their neighbors can come to their assistance. One morning, during my stay at Kamalia, we were all much alarmed by a party of this kind. The king of Fooladoo's son, with five hundred horsemen, passed secretly through the woods, a little to the southward of Kamalia, and on the morning following,

plundered three towns belonging to Madigai, a powerful chief in Jallonkadoo.

"The success of this expedition encouraged the governor of Bangaffi, a town in Fooladoo, to make a second inroad upon another part of the same country. Having assembled about two hundred of his people, he passed the river Kokoro in the night, and carried off a great number of prisoners."

War frequently produces famine, and this calamity, at all events, by whatever cause occasioned, is another prolific source of slavery. The free man makes himself a slave for the sake of subsistence—not because he dreads servitude less, but starvation more. During a severe scarcity which continued in the neighborhood of the Gambia for three years, multitudes of people are said to have taken this course. They came to the Agent or Governor, at the British stations, and begged with great earnestness *to be put upon the slave-chain.* In other cases, the masters of families sold some of their domestics, and perhaps their own children, to buy food for the rest.

Insolvency is another cause mentioned, though this might with some propriety be classed under the head of *crime;* for as such the Africans generally treat it. A negro trader commonly contracts debts on some mercantile speculation, — either from his neighbors, to purchase such articles as will sell to advantage in a distant market, or from the European traders on the coast, — payment to be made in a given time. In both cases, the situation of the adventurer is the same. If he succeeds, he may make a fortune. If he fails, his person and services are at the disposal of another; the insolvent himself as well as his property, being sold to satisfy the debt. The European on the coast is allowed this remedy, as well as the native creditor. He seizes on the delinquent debtor, if he can find him; if not, on some member of his family, or finally on any native of the kingdom; and the prisoner, unless redeemed, will not be released. These rights are not indeed always enforced to their full extent, and probably they are not universally allowed on the coast.

The other offences punished by slavery are chiefly murder, adultery and witchcraft. In the former case, the nearest relative of the deceased may either kill the offender or sell him. In the second, the husband may sell, or accept what he deems an equivalent for his wounded honor. By witchcraft is meant not much more or less than poisoning under the pretence and appearance of magic; but although the Africans are the most credulous and superstitious people on earth, perhaps, this crime is not supposed by travellers among them, or suspected by themselves, to occur very frequently.

When a free man has become a slave by any of the causes we have mentioned, he generally continues so for life, and his children, if born of an enslaved mother, are brought up in the same state. The means of emancipation, however, sometimes occur, and they are quite similar to such as occasionally but not often occur, among the blacks of our own slave-holding states. A slave goes to battle, for instance, and brings in two prisoners as a ransom; or he performs some other signal service which his master acknowledges by granting his freedom. But more frequently he escapes, and the more easily that the master depends rather upon his distance from his native kingdom, and his ignorance of the way thither, than upon any particular means of confinement. The poor sufferer watches sometimes for years before an opportunity presents itself, and during that period shows not the slightest indication of discontent. Those are the most likely to succeed in their purpose, who come from a hilly country, and have therefore been much accustomed to hunting and travel.

Partly for the purpose of illustrating the information we have borrowed in the foregoing pages chiefly from Park, and partly to prove that the same observations apply throughout an immense tract of Western Africa which that enterprising but unfortunate traveller never succeeded in exploring, we shall introduce a few passages from the Journal of the Landers, just published. Those gentlemen did not give their attention to the subject quite so elaborately; but their incidental remarks may

for that very reason be received with quite as much credit, inasmuch as they had no theories of their own to support, and no prepossessions to satisfy. At BADAGRY, on the Northern coast of the Gulf of Guinea, in the latitude of Liberia, the following incident occurred at the visit which the English paid to the chieftain or king of the place. "In him we found a meek and venerable old man, of respectable appearance. He was surrounded by a number of men and boys, his household slaves, who were all armed with pistols, daggers, muskets, cutlasses, swords, &c, the manufacture of various European countries. In the first place, he assured us that nothing could give him more pleasure than to welcome us to Badagry; and he very much wondered that we had not visited him before. If we had a present to give him, he said he would thank us, but if we had not, still he would thank us. A table was then brought out into the court before the house, whereon decanters and glasses, with a burning liquor obtained from the Portuguese, were placed. In one corner of the yard was a little hut, not more than two feet in height, wherein had been placed a Fetish figure, to preserve the chief from any danger or mischief which our presence might otherwise have entailed upon him. A portion of the spirit was poured into one of the glasses, and from it emptied into each of the others, and then drunk by the attendant that had fetched it from the house. This is an old custom, introduced, no doubt, *to prevent masters from being poisoned by the treachery of their slaves.*"

The persons described in our next extract, which relates to the same place and the same potentate, seem to be of the class called by Park domestic slaves.

"Owing to the holiday, which is equally prized and enjoyed by Mohammedan and pagan, our visiters today have been almost exclusively confined to a party of Haussa mallams, who entered our dwelling in the forenoon, perfumed all over with musk, more for the purpose of gratifying their vanity by displaying their finery before us, than of paying us the compliments of the day, which was avowedly the sole object of their intrusion. One or two of them were masticating the goora-nut; and others

had their lips, teeth, and finger nails stained red. Each of the mallams was attended by a well-dressed little boy of agreeable countenance, who acted as page to his master and was his *protege*. Neither of the men would eat or drink with us; yet while they were in our company they seemed cheerful and good-humored, and were communicative and highly intelligent. In answer to our questions they informed us that two rivers enter Quorra or Great 'River' at Funda, one of which is called the *Coodoonia* and the other the *Tshadda* (from the lake Tshad)—that a schooner might sail from Bornou to Funda on the latter river without difficulty — that Funda is only twenty four hours' pull from Benin; and twentynine days' journey from Bornou. At the close of a long and to us rather interesting conversation, our visiters expressed themselves highly gratified with their reception, and left the hut to repair to their own habitations. These men, though *slaves to Adooley*, are very respectable, and are never called by their master except when required to go to war, supporting themselves by trading for slaves, which they sell to Europeans. They wore decent Nouffie tobes, Arab red caps, and Haussa sandals; and both in their manners and conversation the mallams are infinitely superior to the ungentle and malignant natives of Badagry."

These people sometimes come to still better fortune. "The former governor of Jenna, who treated the gentlemen composing the last mission so handsomely, died about fifteen months ago, and the King of Yarriba *chose one of the meanest of his slaves as his successor*. This is an invariable rule with the sovereigns of that country, of which Jenna is a province; for they fear that its distance from the capital being very great, a person of higher rank, if possessed of talents and spirit, could easily influence the natives to throw off the yoke and declare themselves independent of Yarriba." * * *

"Since the demise of the late governor, it is calculated that Jenna has lost more than five hundred of its population, chiefly by wars, intestine broils, &c, and for want of a ruler. It must not be imagined, however, that because the people of this country are almost per-

petually engaged in conflicts with their neighbors, the slaughter of human beings is therefore very great. They pursue war, as it is called, partly as an amusement, or to 'keep their hands in it;' *and partly to benefit themselves by the capture of slaves.* As we were sailing down the coast, we wore told that the natives of Cape La Hoo and Jack-a-Jack had been warring for three years previously, and were still at variance; but, during that long period, only one single decrepit old woman, who found it no easy matter to run as fast as her countrymen, was left behind, and became the solitary victim of a hundred engagements. Much after the same fashion are the bloodless wars of Jenna. Success depends much more on the cunning and address of the parties, than on any extraordinary display of intrepidity; and living, not dead, subjects are sought after; so that it is their *interest* to avoid hard blows, and enrich themselves by the sale of their prisoners. Perhaps the extraordinary decrease in the population of Jenna has arisen from the desertion of slaves, who embrace the opportunity, while their masters are from home, engaged in predatory excursions, of running away; and thus the latter frequently become losers instead of gainers, by their unnatural passion for stealing their fellow creatures. The individuals captured are sent to the coast, and the chiefs of those unsettled and barbarous tribes that inhabit it are appointed agents to regulate the sale, for which they receive half the profits."

Between CHOW and EGGA, on the route from the coast across the country to the Niger, "we found numbers of people of both sexes in the path, who were returning from Egga to Chow, and several naked boys on their way to the coast, under the care of guardians. These are slaves, and will be sold most likely at Badagry. Women bore burdens on their heads that would tire a mule, and children not more than five or six years of age trudged after them, with loads that would give a full grown person in Europe the brain fever." * * *

"Several chiefs on the road have asked us the reason why the Portuguese do not purchase as many slaves as formerly; and make very sad complaints of the stagnation

in this branch of traffic. * * We met many hundreds of people of both sexes and all ages, with vast quantities of bullocks, sheep, and goats, together with fowls and pigeons, which were carried on the head in neat wicker baskets. Several of the travellers were loaded with packages of country cloth, and indigo in large round balls. They are all slaves, and were proceeding to the coast from the interior, to sell the goods and animals under their charge. One old woman had the misfortune to let a large calabash of palm-oil fall from her head: on arriving at the spot we found a party of females, her companions in slavery, wringing their hands and crying; the old woman's own affliction was bitter indeed, as she dreaded the punishment which awaited her on her return to her master's house. I compassionated her distress, and gave her a large clasp-knife, which would more than recompense her for the loss of the oil, whereat the women wiped away their tears, and fell down on the dust before us, exhibiting countenances more gladsome and animated than can be conceived."

At Lazipa, on the same route, "three men, inhabitants of Acboro, were captured by a gang of restless, marauding scoundrels, who are denominated here, as elsewhere, 'war-men of the path,' but who are, in reality, nothing more nor less than highway-robbers. They subsist solely by pillage and rapine, and waylaying their countrymen. The late governor of Acboro was deposed and driven from the town by his own people, for his indifference to their interests, and the wanton cruelty with which he treated them and their children. At different times he seized several individuals of both sexes, and sold them as slaves, without assigning any cause for the act. This drew on him the vengeance of the friends and relatives of the sufferers, who prevailed on their townspeople to rise with them and punish the aggressor."

We now come to the banks of the Niger, and are soon informed, "that the inhabitants of many of the numerous walled towns and open villages on the banks of the Niger and also of the island, we find, are for the most part Cumbrie people — a poor, despised, and abused,

but industrious and hard-working race. They are but too often oppressed and persecuted by their more fortunate and powerful neighbors, who affirm that they are fitted by nature only for slaves, and therefore invariably treated by them as such.

"The Cumbrie also inhabit many parts of Haussa and other countries; they speak different languages, but they have all the same pursuits, superstitions, amusements and peculiar manners, to which they firmly and scrupulously adhere, both in good and bad fortune, in sickness and in health, in freedom and slavery, at home and in foreign countries, notwithstanding the scorn and derision to which it subjects them; and they are known to cherish and maintain them to the end of life, with as much pertinacity as the Hebrew does his faith and national customs. Inheriting from their ancestors a peaceful, timid, passionless, incurious disposition, they fall an easy prey to all who choose to molest them; they bow their necks to the yoke of slavery without a murmur, and think it a matter of course; and perhaps no people in the world are to be found who are less susceptible of intense feeling and the finer emotions of the human mind, on being stolen away from their favorite amusements and pursuits, and from the bosom of their wives and families, than these Cumbrie people, who are held in such general disesteem. Thousands of them reside in the kingdom of Yaoorie and its province of Engarski; and most of the slaves in the capital have been taken from among them."

These oppressed people, who must strongly remind the reader of ancient history, of the Spartan Helots, sometimes show the same spirit also which the Helots did, and with the same success.

"The tribute, or rather rent, which they pay to the sultan for the land they cultivate, consists of a quantity of corn, about the size of a bundle as much as a man can carry, for every plot of land, whether it be large or small. When, however, the harvest fails, they are at liberty to give a certain number of cowries in lieu of the accustomed duty of corn. If the poor have no

means of paying their rent when it becomes due, the sultan immediately despatches a body of horsemen to their villages, with a command to seize and carry away as many of the people as they may think proper. It sometimes happens, however, that the sultan of Yaoorie pulls the reins of oppression with too tight a hand; and as cowards, when driven to desperation, often give specimens of extraordinary courage and resolution, so the negligent and despised Cumbrie, writhing under the lash of injuries which they have never deserved, defend themselves with extraordinary determination and bravery, and not unfrequently come off victorious from the conflict. The benefit which results to them from these advantages is an exemption from the payment of rent for two or three subsequent years."

From these extracts, the authenticity of which may be safely relied upon, as well as from the information of other intelligent and faithful travellers, it might be inferred, that the *number* of slaves in Africa, even as compared with that of the free population, must be immense, and such proves to be the fact. The West Indies are scarcely in any instance a more remarkable illustration of the extent to which this system may be carried. Mr Park supposes the bond men throughout the continent to be in the proportion of three to one, compared with the free; and the Landers, though they make no general observations of this kind, and were certainly not so well qualified by leisurely examination to do so, yet mention particular instances which go to confirm the same inferences. In one case they supposed the slaves to constitute four fifths of the whole population of a small kingdom. Their distance from home, their ignorance, despair, want of arms, the force of even long-continued imposition, together with the *usual* comparatively lenient discipline of their owners, must be the principal circumstances explanatory of the continuance of this singular state of society. Even in South Carolina, where the blacks are more numerous, proportionally, than in any other part of the United States, there is not much disparity in the number of the two classes. In some of the West

Indies, the proportion equals that of the African kingdoms, and in some cases even exceeds it. In ancient Athens, at one time, the slaves are said to have been *ten-fold* more numerous than the free!

Having given a view of the character, condition and customs of Africa, in which slavery, and thence the slave-trade, properly so called, have their origin, we are now prepared to consider that branch of the latter in which foreign nations have been concerned, and which might be entitled as well the EUROPEAN and AMERICAN, as the African slave-trade.

The domestic trade, supplied by war and the other sources heretofore mentioned, is the foundation of the foreign. Large slave-markets are maintained in the large cities of Central Africa, and in these the unfortunate victims are gradually accumulated, from hand to hand, and from kingdom to kingdom. Here fairs are held, and merchants assemble from all quarters; and then again the streams of traffic go forth, by caravans or coffles, in a hundred directions, leading, — like the blood-vessels of the human system from the heart, — to the farthest extremities of the continent.

The famous city of TOMBUCTOO, on the Niger, in about the latitude of Cape Verd, (14° north,) holds a distinguished rank among the slave-markets. Our countryman, Adams, who was wrecked on the Northern African coast, in 1810, visited this city, and remained there six months; during which time the inhabitants were accustomed to set out monthly in marauding parties of from one to five hundred, among the neighboring tribes, from which they rarely return empty-handed.

Captain Riley met with a misfortune similar to that of Adams, about five years afterwards, and he too visited Tombuctoo. Beyond this, at WASSANAH, a city considerably larger, and the king of which was proprietor of many thousand slaves, the traveller's interest was much excited by accounts of expeditions sent down the river, consisting of numerous boats with large cargoes of these unhappy creatures. They were described *as sailing two months, first south and west, till they came to the great water, where they met pale people with large boats, and*

guns which made a noise like thunder. This description, it will be observed, agrees remarkably with the Landers' navigation of the Niger. Undoubtedly the same river is intended: nor can there be the least doubt, that this mighty stream has been for centuries a principal channel of the horrible traffic under discussion.

The foreign nations who have chiefly been concerned in the African slave-trade, in various times and places, may be classed under two heads: first, those resident within, and secondly those without, the limits of the Continent. By the former we mean the Barbary States more particularly. The Landers say, in the first volume of their Journal:—"The Skeikh [king] of Bornou has recently issued a proclamation, that no slaves from the interior should be sent for sale farther west than Wowow, so that none will be sent in future from thence to the sea-side. The greatest and most profitable market for slaves is said to be at Timbuctoo, whither their owners at present transport them to sell to the Arabs, *who take them over the Deserts of Zahara and Lybia, to re-sell them in the Barbary States.*"

This branch of the traffic extends into Turkey in Europe, where the poor wretches who are purchased in Central, and conveyed over the vast breadth of Northern Africa, are not unfrequently sold for about $250 each.

But on the Western coast, for several thousand miles, a more extensive wholesale trade has been carried on by the Portuguese, the Spaniards, the French, the Dutch, the English and the Americans, with some assistance from other christian and civilized nations—with what several qualifications we shall soon have occasion to observe.

The Portuguese were the first to become acquainted with Western Africa, about the middle of the fifteenth century, and not very long before the discovery of America, when navigation, commerce and enterprise commenced a new career. They explored the Senegal in 1447; and the Gold Coast, (as they called it,) Benin, and other districts around the Gulf of Guinea, in 1470,—building in this quarter the city of Elmina, (the Mine,) and making it the capital of all their increasing African possessions. In 1484, they ascended the Congo, much farther south,

and carried off some of the natives to Portugal, whom, however, they were yet honest enough to return in 1490. At this time, few if any settlements are maintained on the coast by this nation, although none, as we shall see, has been heretofore more deeply involved in the business of kidnapping and carrying off the inhabitants.

The Spaniards have also maintained an enormous share in the traffic, ever since the early part of the sixteenth century. The first occasion of it was in the strangely misguided zeal, — perhaps we should say, benevolence,—of Queen Isabella, who undertook to rescue the native West Indians from the extinction to which *they* appeared to be rapidly hastening, by importing negroes, who should do the hard and hot work of the island, — for which they were thought to be much the better qualified of the two races. The commerce which begun thus, was destined to have a bearing on the destinies of both continents, which the queen of Castile probably had not the penetration to foresee.

The Dutch commenced operations on the African coast early in the seventeenth century, the Portuguese retiring before them, and even Elmina falling into their hands in 1637. But the Dutch in their turn were soon rivalled and superseded by the English and French; and from this time, numerous settlements and stations were made and maintained by them all — many of which still remain, or at least the ruins of them, — for the purpose of facilitating the exportation of slaves principally, though partially for the promotion of discovery in the interior of the Continent. The English explored the Gambia in 1620, where they found the Portuguese had gone before them. The French ascended the Senegal in 1637, and a second time in 1697, and a lively commerce in gums, as well as slaves, was soon established by that active people with the natives on the borders and at the mouth of the river. The Gambia was explored again by the English in 1723, and great discoveries made. In the latter part of the same century, our own countryman, Ledyard, — the Englishmen, Lucas, Houghton, Park, — and the German, Hornneman, and others, added much to our previous knowledge of Northern and

Western Africa, as many other travellers have done since.

We mention these facts, going to show the progress of information respecting this continent, because it is to this information that we are ultimately indebted also for a knowledge of the real character of the slave-trade, and subsequently for the active and benevolent measures which will appear to have been taken in the hope of suppressing it. We shall only add here, that the first blacks actually carried across the Atlantic as slaves, were taken from the Portuguese settlements over to the Spanish West Indies; that the earliest similar act of the English took place in 1562, during the reign of queen Elizabeth; though the first Africans imported into the United States, as far as we can learn, were brought into Virginia by a Dutch Captain, a little more than two centuries since.

Since then, and especially during the whole of the last century, the traffic has been carried on to a monstrous extent. The petty districts along the coast have been gradually exhausted by the demand, and even desolated by the neighborhood of the foreign trade, until Central Africa has become the principal source of slaves. The shores of Western Africa seem to have been by nature unfortunately well adapted to this business, even after it became illegal. It is not only intersected by numerous long and navigable rivers, assisting very materially the intercourse of the inland barbarians with the coast, but the coast itself is indented with innumerable bays, islands, creeks, coves and rivers, covered and almost concealed by a prodigious growth of the most luxuriant forest and shrubbery in the world. Here settlements have been founded, and stations built in former times, and here haunts have been appointed and frequented more latterly, where slaves were brought in and carried off, openly or covertly, from all parts of interior Africa to almost all parts of the remainder of the globe.

[To be concluded.]

SCIENTIFIC TRACTS.

VOL. II......NO. XXII.

AFRICAN SLAVE TRADE.

[Concluded.]

We have now to state some facts respecting the EXTENT of the trade, which, for the sake of brevity, we shall do in round numbers. Mr Wilberforce said, in 1789, in the British Parliament, and upon the best evidence, that the number of slaves then *annually* carried from the African coast *in British vessels*, was about 38,000, of whom 22,500 were taken to the British Islands. This was before any measures had been taken for the suppression of the trade, which we shall presently refer to. In 1826, the London African Institution, who were possessed of the most complete and correct means of information, stated to Lord Castlereagh, that the whole number of slaves then carried out from Africa every year, was over 50,000; that during twentyfive years previous, the number had sometimes been 80,000; and that the number carried off during those twentyfive years, in all, must be about one million and a half. The abolition of the slave-trade by the British Parliament had taken place in 1808, and had no doubt operated to reduce the amount in the degree indicated by a comparison of these estimates.

The Society also stated, that about 1795 the English share of the trade rose to the enormous amount of 55,000 in a single year. The Portuguese are supposed to have taken off from 20,000 to 25,000 at this time; and the Americans about 15,000. After the year 1810, what-

ever slave-trade the Americans carried on, was under disguise of either the Spanish or Portuguese flag, but chiefly the former. These two flags indeed for a long time covered most of the traffic,—about half of the 50,000 slaves exported in 1816, as we have just mentioned, being taken under one, and the residue under the other. Most of the other nations concerned in it, had then declared against the practice, though their subjects continued it in disguise. Notwithstanding the nominal checks imposed by various nations at this time on the traffic, it may be doubted whether it has materially diminished.

By this country and by Great Britain it has been declared piracy, and punishable as such; and such measures had been adopted by the other Christian Powers, previous to 1821, that at that date no flag could legally cover the trade North of the Line. But not only has it prevailed South of the Line since then, but to a vast extent on all parts of the coast; partly owing to the facilities for evasion already mentioned, and partly to the flagrant hardihood of the Portuguese and other captains, who have armed their fleet vessels, and bid defiance both to pursuit and to punishment. In the first month of 1825, 5,766 negroes were landed within twenty leagues of Havana, a large part of them from French vessels.

At the place last named, the traffic has taken refuge in the most shameless manner. In one instance when a British cruiser had chased a slave-vessel, the Minerva, into port, the slaves were landed, while the Government were pretending to inquire into the complaint of the British officer who was sent on shore; and at this the authorities connived, and screened the delinquents. On searching a steam-vessel bound to Matanzas, however, this officer found fourteen of the negroes stowed away between the bulk-heading, which separated the boilers from the vessel's side, and exposed to the intense heat produced by the lighted stoves! Six females were found concealed under a coil of ropes and a hawser. These wretched beings thought at first that they were doomed to death, but on being undeceived their joy was excessive.

Not many years since, the Brazils were quite as distin-

guished for their share in the business. One vessel, the Intrepida, of one hundred tons' burden, when captured, was found to contain 310 slaves, in a state of great wretchedness and emaciation; and seventy others had died in a passage of 46 days. — Another, the Invincible, contained 446 slaves, so crowded together, that it was impossible to separate the sick from the healthy, or the dying from the dead; their provisions and water were of the worst kind; the filth and stench was beyond description; and the dysentery, opthalmia, and scurvy, carried off 186 of these poor wretches in less than sixty days.

The government of Brazil contracted with Great Britain, in 1827, to put an end to their traffic in three years, and recently it is supposed to have been somewhat concealed, if not suppressed. — These facts, — to which we shall only add that the entire number of Africans carried off from their native country into servitude, since the commencement of the trade, has been computed at 180,000,000, — abundantly illustrate its enormous and otherwise incredible EXTENT. Some of them illustrate also, the horrors of the process as regards the individual sufferers. But upon this subject we shall give further information.

In 1789, an estimate was made in England, from actual measurement of slave-vessels, and the calculation of the number of slaves commonly carried, from which it appeared that, allowing to every man six feet by one foot four inches for room, to every woman five feet by one foot four, to every boy five feet by one foot two, and to every girl four an half feet by six, 450 slaves might be stowed into one vessel examined. It appeared, however, that this same vessel carried 454. The right ancle of one was generally fastened to the left ancle of another by an iron fetter; and in case of turbulence, by another at the wrists. They were placed in niches, and along the deck, in such a manner that it was impossible to pass among them without treading upon them. The stench was intolerable. The allowance of water was so deficient, that the wretched victims were frequently found gasping for life. Their food was the least and worst upon which man could live. Thus starved as they were, they often desperately refused to eat, and nothing but torture finally

compelled them. In other instances they jumped overboard, whenever a fortunate opportunity occurred, waving their arms aloft in exultation. In still more, and in greater numbers, they were thrown over, or otherwise despatched, by the traders, either through fear of pursuers, or of the slaves themselves, or from disease or want of provisions to maintain the whole number.

Some are killed in the act of *kidnapping*, for purchasing is not the sole means adopted by the piratical traders. Mr Clarkson, an Englishman distinguished for his exertions against the trade, was informed by a man who had been on board an African Slaver, that he had been two expeditions up the river Calabar in the canoes of the natives. In the first of these, they came within a certian distance of a village. They then concealed themselves under the bushes, which hung over the water from the banks. In this position they remained during day-light. But at night they went up to it armed; and seized all the inhabitants, who had not time to make their escape. They obtained fortyfive persons in this manner. In the second they were out eight or nine days; when they made a similar attempt, and with nearly similar success. They seized men, women and children, as they could find them in the huts. They then bound their arms, and drove them before them to the canoes. In another instance, a slave ship had struck on some shoals, called the Morant Keys, a few leagues from the east end of Jamaica. The crew landed in their boats, with arms and provisions, leaving the slaves on board in their irons. This happened in the night. When morning came, it was discovered that the negroes had broken their shackles, and were busy in making rafts; upon which afterwards they placed the women and children. The men attended upon the latter, swimming by their side, whilst they drifted to the island where the crew were. But what was the sequel? From an apprehension that the negroes would consume the water and provision, which had been landed, the crew resolved to destroy them as they approached the shore. They killed between three and four hundred. Out of the whole cargo only thirtythree were saved, who, on being brought to Kingston, were sold.

The Abolition Society of Paris, stated a few years since, that traders threw over three thousand of their victims into the sea, yearly, for various reasons. We are told that one of these ruffians, named Gibbin, had carried off from the Galinas, about six weeks before, 250 slaves whom he intended to introduce surreptitiously into Gaudaloupe. He succeeded in landing the whole, except sixtyfive, when, having observed a French cutter coming towards the vessel, he threw those sixtyfive miserable beings overboard, in order to avoid discovery of the traffic he had been carrying on! The governor of Gaudaloupe, it is added, gave orders to seize the murderer, when the crime he had perpetrated was discovered by the dead bodies that were drifted ashore; but he had sailed before the order could be executed.

The following extract from another source may also be relied on. The informant was an American, engaged formerly in the business. "He had been to Africa five times to obtain slaves. On one occasion, when an insurrection was apprehended, two hundred of the wretched beings were shot dead. Forty was about the number of deaths, which took place each voyage, except the last, when the loss was but ten; the number purchased each time being about four hundred. Another sailor, who has twice visited the African coast for slaves, states that from about 800, the cargo each time, 113 died during one voyage, and eightyseven during another. The boatswain informs me, that when he went to the Congo for slaves, out of 400, the number taken on board, 80 died on the passage."

It is only a few years since, in a Spanish ship, boarded by a British man-of-war, "after a diligent search, 240 slaves were found concealed. They were in the most dreadful state imaginable, — having, in their confined situation, disease and starvation to contend with at once. The vessel had been at sea fortyseven days, from the coast of Guinea; and when captured, had only one day's provision on board. A yam being thrown among the wretched negroes, they fought for it like hungry dogs."

We will here add a few facts which show (if *any* thing can show,) more strongly the atrocities and horrors of

this trade. — In 1818, 22,231 slaves, were embarked on the coast of Africa for Rio de Janeiro; of which number 19,802 only arrived at that place, 2,429 having died on the passage. One vessel lost 161 out of 421; another, 229 out of 659; a third, 238 out of 464. — By an official document from Rio de Janiero, it appears that the following importations of slaves were made into that port in 1826 and 1827.

1826, landed alive, 35,966; died on the passage 1,905.

1827, landed alive, 41,384; died on the passage 1,643.

We shall conclude this disagreeable part of our subject, with several of the cases stated by the African Institution, which may be considered a fair indication of the average slave-vessels.

1. The Venus Havannera, under Spanish colors, of the burden of about 180 tons, carried off from the river Bonny, 530 slaves. When captured on her passage to the Havana, and carried into Tortola, the mortality was found to have amounted to 120.

2. La Mannella, a ship of the burden of 272 tons, sailed under the Spanish flag, and took on board in the river Bonny, 642 slaves. The deaths on the passage to the West Indies, previous to her capture, amounted to 140.

3. The Gertrudes, a ship sailing under the Spanish flag, took on board upwards of 600 slaves. This ship was taken while yet on the African coast, and brought to Sierra Leone for adjudication. But notwithstanding the short time that had elapsed since the slaves were taken on board, such was the dreadful state of crowding, that about 200 died before the ship was brought in, or within a short time after her arrival; many, even of those who survived, were so much debilitated by their sufferings, as never to be likely to enjoy sound health.

4. Nueva Constitucion, a vessel under the Spanish flag, of only 30 tons' burden, had on board 81 slaves; but having been brought in, within a few days after the slaves had been taken on board, the bad effects which must have followed such a state of crowding on a very long passage, were prevented.

5. The Maria Primeira, a ship under Portuguese

colors, took on board upwards of 500 slaves. This number was reduced to 403, in consequence of extreme crowding, before she was brought into Sierra Leone; and nearly 100 more died soon after, in consequence of the diseases contracted on board.

6. Portuguese brig, San Antonio, of 120 tons, took on board 600 slaves. When captured, although she had only sailed 80 leagues, 30 slaves had already died; and many more were found to be in a dying state, and died soon after. The capturing officer took 150 of the slaves on board his own ship, to prevent the almost universal mortality he apprehended. When he first went on board the slave ship, he found a dead body, in state of absolute putridity, lying among the sick.

7. The Spanish ship Carlos, under 200 tons' burden, took on board 512 negroes, in addition to a crew consisting of 84. About 80 slaves had died previous to her capture, and the rest were in a most deplorable state. Many more instances might be added; but these may be considered as exhibiting the ordinary rate of mortality on board the ships engaged in the illicit slave trade.

The remaining cases will more particularly explain the effects of disease on board a slave-vessel; and the last one, the manner in which the traders not unfrequently destroy and plunder each other.

"The ship Rodeur, Captain B——, of two hundred tons' burden, left Havre, the 24th of January, 1819, for the coast of Africa, and reached its destination the 14th of March, following, anchoring at Bonny, in the river Calabar. The crew consisting of twentytwo men, enjoying good health during the outward voyage, and during their stay at Bonny, where they remained till the 6th of April. Fifteen days after they had set sail on the return voyage, they remarked, that the negroes, who, to the number of one hundred and sixty, were crowded together *(entasses)* in the hold and between decks, had contracted a considerable redness of the eyes, which spread with singular rapidity. No great attention was at first paid to these symptoms, which were thought to be caused only by the want of air in the hold and by the scarcity of water which had already begun to be felt.

At this time they were limited to eight ounces of water a day, which quantity was afterwards reduced to the half of a wine glass. By the advice of M. Maignan, the surgeon of the ship, the negroes, who had hitherto remained shut up in the hold, were brought upon deck in succession, in order that they might breathe a purer air. But it became necessary to abandon this expedient, salutary as it was, because that many of those negroes, affected with *Nostalgia*, (meaning the passionate desire to revisit their native land) threw themselves into the sea, locked in each other's arms.

"The captain caused several of the negroes, who were prevented in the attempt to throw themselves overboard, to be shot and hung, in the hope that so terrible a spectacle might deter others from a similar conduct. But even this severity proved unavailing, and the slaves were again confined entirely to the hold.

"The disease which had spread itself so rapidly and frightfully among the Africans, soon began to infect all on board, and to create alarms for the crew.

"The sufferings of the people, and the number of the blind, augmented every day; so that the crew, previously alarmed by the apprehension of a revolt among the Negroes, were seized with the farther dread of not being able to make the West Indies, if the only sailor who had hitherto escaped the contagion, and on whom their whole hope rested, should become blind like the rest. This calamity had actually befallen the *Leon*, a Spanish vessel, which the Rodeur met with, on her passage, and the whole of whose crew, having become blind, were under the necessity of altogether abandoning the direction of their ship. They entreated the charitable interference of the Rodeur: but the seamen of this vessel could not either quit her to go on board the Leon, on account of the cargo of negroes, nor receive the crew of the Leon on board the Rodeur, in which there was scarcely room for themselves. The difficulty of taking care of so large a number of sick, in so confined a space, and the total want of fresh meat and of medicines, made them envy the fate of those who were about to become the victims of a death which seemed to them inevitable, and the consternation was general.

"The Leon has not been heard of since, and doubtless was lost.

"The Rodeur reached Gaudaloupe on the 21st of June, 1819, her crew being in a most deplorable condition. Of the negroes, thirtynine had become perfectly blind, twelve had lost an eye, and fourteen were affected with blemishes more or less considerable. Of the crew, twelve lost their sight entirely, among whom was the surgeon; five became blind of one eye, one of them being the captain; and four were partially injured. Of the captain, it is added, that 'he did not cease in the midst of the greatest danger, to lavish his attentions on the negroes and the sailors, with a zeal and devotedness which exceed all praise."

" Such is the account of the voyage of the Rodeur, as gives by M. Guillie. But in this account, one of the most horrid circumstances connected with the transaction is wholly omitted, probably because it illustrated no medical principle; namely, the fact, that the slaves who are stated to have become blind were thrown into the sea and drowned. * *

"In the month of September, 1820, the Sieur Lemoine, master and owner of the schooner l'Espoir, or the Bamboche, left the Mauritius, under English colors, shaping his course towards the coasts of Madagascar and of the Mozambique. He fell in with a Portuguese vessel, laden with negroes and gold dust. An eagerness and thirst of gain seized upon his soul : he run along-side of the Portuguese vessel, and immediately killed the mate by a musket shot: having boarded her, he soon obtained possession of the vessel thus attacked ; and his first questions were addressed to a Portuguese Colonel, aged 50, of whom he inquired where the money and gold dust were deposited. After this short interrogatory, Lemoine purposely stepped aside, and a man named Reineur, who was behind him with a pistol, blew out the unfortunate Colonel's brains. But these crimes were not enough to satisfy their savage inhumanity. The master of the captured vessel, alarmed by the rapid succession of these massacres, threw himself overboard, in order to escape a more immediate death. Vain hope! the fury of Le-

moine and his accomplices were not yet allayed. They pursued him in a boat, and, having soon overtaken him, they cut him on the head with a sabre. The unfortunate man, feeling himself, wounded, caught hold, in order to support himself, of the boat in which his murderers were, who profiting by this last effort of despair, had the dastard cruelty to run a sword into his throat, the point of which came out at the side of their victim: the body disappeared, and they returned on board fatigued, but not satisfied with murders! They shut up in the hold, the remaining Portuguese sailors, and after having taken off the rich cargo, they scuttled the ship and sunk her with the crew they had thus shut up."

Not to pursue any farther the shocking detail of suffering on the part of the slaves, we have next to consider the effects of the traffic or other parties concerned. We allude particularly to the Africans tribes, who in one form or another supply the traders; but previous to any remarks upon their case, it may be proper to refer to that of the traders themselves, and especially of the mariners in their employ.

About the year 1790, when the whole export tonnage from Liverpool amounted to 170,000 tons, and the portion of it which visited Africa to only 13,000, it was satisfactorily ascertained that more seamen died in the latter department in a year, than in the whole remaining trade in twice that time. Of 916 engaged in it, 216 died in 1788; while upon a fair average of the same number of men employed in the trades to the East and West Indies, Petersburg, Newfoundland and Greenland, no more than 87 died. Of 3170, who left Liverpool during 1787, in the slave-ships, only 1428 had returned. In 1781, Mr Wilberforce stated in the British Parliament, that in 350 slave-vessels having on board 12,263 persons, 2644 were lost in twelve months; whereas in 462 West Indiamen, having on board 7640 persons, only 118 were lost in seven months:

The causes of this frightful result were various. 1. The nature of the employment itself, and particularly that part of it carried on upon the African coast. It was and is a system of stratagem, delay, conflict, and desperate effort, — in fact a completely piratical system — in a region the

most fatal to human life which can be found upon the globe. The interior of the continent is generally as healthy as any other part of the world; but the coast is in most cases low, flat, hot, and covered with thick and tangled under-brush, which at once excludes the sun, and furnishes the best possible staging as it were, whereon to hang, for a continual supply of corruption, all the mud, slime and offal washed up by the tides. A vessel can hardly stay in the mouth of one of the rivers under these circumstances, a week at one time, without imminent danger to the lives of all on board. And yet some of them lay off and on, waiting and watching their opportunities of plunder, traffic or departure, as the case may be, month after month during the most sickly season of the whole year. Hundreds of descriptions to this effect, the authenticity of which admits of no doubt, might be collected; but we shall give only one, and by no means an extreme case, from the Journal of the Landers, chiefly from its being the most recent we have met with. In November, 1831, those travellers reached the mouth of the Niger, on their return from the interior of Western Africa, and by way of one of its large branches called the Nun. They say, —

"About a quarter of an hour after we had entered the river Nun, we descried at a distance before us, two vessels lying at anchor. The emotions of delight which the sight of them occasioned are quite beyond my powers of description. The nearest to us was a Spanish slave vessel, whose captain we had seen at Brass town. Our canoe was quickly by her side, and I went on board. The captain received me very kindly, and invited me to take some spirits and water with him. He complained sadly of the sickly state of the crew, asserting that the river was extremely unhealthy, and that he had only been in it six weeks, in which time he had lost as many men. The remainder of his crew, consisting of thirty persons, were in such a reduced state, that they were scarcely able to move, and were lying about his decks more resembling skeletons than living persons. I could do no good here, so I took my leave of the captain, and returned to the canoe."

The residue of the adventure needs no comment.

"We now directed our course to the English brig, which was lying about three hundred yards lower down the river. Having reached her, with feelings of delight mingled with doubt, I went on board. Here I found everything in as sad a condition as I had in the schooner; four of the crew had just died of fever; four more, which completed the whole, were lying sick in their hammocks, and the captain appeared to be in the very last stage of illness. He had recovered from a severe attack of fever, and had suffered a relapse in consequence of having exposed himself too soon, which had nearly been fatal to him. I now stated to him who I was, explained my situation to him as fully as I could, and had my instructions read to him by one of his own people, that he might see I was not imposing on him. I then requested that he would redeem us by paying what had been demanded by King Boy, and assured him that whatever he might give to him on our account would certainly be repaid him by the British government. To my utter surprise and consternation, he flatly refused to give a single thing, and ill and weak as he was, made use of the most offensive and shameful oaths I ever heard. 'If you think,' said he, 'that you have a —— fool to deal with, you are mistaken; I'll not give a b——y flint for your bill; I would not give a —— for it.' Petrified with amazement, and horror-struck at such conduct, I shrunk from him with terror. I could scarcely believe what I had heard, till my ears were assailed by a repetition of the same. Disappointed beyond measure by such brutal conduct from one of my own countrymen, I could not have believed it possible; my feelings totally overpowered me, and I was ready to sink with grief and shame. I returned to the canoe, undetermined how to act, or what course to pursue. Never in my life did I feel such humiliation as at this moment. In our way through the country we had been treated well; we had been in the habit of making such presents as had been expected from us; and, above all, we had maintained our character among the natives, by keeping our promises. This was now no longer in my power, as my means were all expended; and when, as a last, and, as I had imagined, a certain resource, I had

promised the price of our ransom should be paid by the first of our countrymen that we might meet with, on the best of all securities, to be thus refused and dishonored by him would, I know, degrade us sadly in the opinion of the natives, if it did not lessen us in our own.

"As there were no hopes that the captain of this vessel would pay anything for us, I went on board again, and told King Boy that he must take us to Bonny, as plenty of English ships were there. 'No, no,' said he, 'dis captain no pay; Bonny captain no pay; I won't take you any further.' As this would not do, I again had recourse to the captain, and implored him to do something for me, telling him that if he would let me have only ten muskets, Boy might be content with them, when he found that he could get nothing else. The only reply I received was, 'I have told you already I will not let you have even a flint, so bother me no more.'— 'But I have a brother and eight people at Brass town,' I said to him; 'and if you do not intend to pay King Boy at least persuade him to bring them here, or else he will poison or starve my brother before I can get any assistance from a man-of-war, and sell all my people."

"The only answer I received was, 'If you can get them on board, I will take them away; but as I have told you before, you do not get a flint from me.' I then endeavored to persuade Boy to go back for my people, and that he should be paid some time or other. 'Yes,' said the captain, 'make haste and bring them.' Boy very naturally required some of his goods before he went, and it was with no small difficulty I prevailed on him afterward to go without them."

After this exposition, which familiarly but fairly illustrates the common character of the traders, it is obvious to remark, that another cause of mortality among the *sailors* is the inhumanity of those who employ them. Hence the traffic became in such disrepute in England, previous to the abolition, that nothing but force, or fraud, —such as getting the seamen on board by intoxication, or inducing them to sign the shipping-papers without reading the articles,—could effect the manning of a slave-vessel.

A third cause is in the resistance and retaliation not

unfrequently made by the natives of the coast on occasions, which occur but too often, when oppression is carried beyond the capacity of the most servile endurance. The spirit which they are capable of manifesting appears from an anecdote related by Mr Clarkson as follows: —

"The captain of an English vessel, lying in the river Cameroons, sent his boat with three sailors and a slave to get water. A black trader seized the latter, and took him away. He alleged in his defence, that the captain owed him goods to a greater amount than the value of the slave; and that he would not pay him.

"This being told on board, the captain, and a part of his crew, who were compelled to blacken their naked bodies that they might appear like the natives, went on shore at midnight, armed with muskets and cutlasses. They fired on the trader's dwelling, and killed three of his children on the spot. The trader, being badly wounded, died while they were dragging him to the boat; and his wife being wounded also, died in half an hour after she was on board the ship. Resistance having been made to these violent proceedings, some of the sailors were wounded, and one was killed. Some weeks after this affray, a chieftain of the name of Quarmo went on board the same vessel to borrow some cutlasses and muskets. He was going, he said, into the country to make war; and the captain should have half of his booty. So well understood were the practices of the trade, that his request was granted. Quarmo, however, and his associates, finding things favorable to their design, suddenly seized the captain, threw him overboard, hauled him into their canoe, and dragged him to the shore; where another party of the natives, lying in ambush, seized such of the crew as were absent from the ship."

The result does credit to the moderation of the negroes, for they contented themselves with simply compelling the captain to give an order on the ship for the payment of his debts. In a vast number of cases they have been provoked to a much more severe exhibition of their sense of justice.

The effects of the slave-trade on AFRICA itself have been terrible beyond conception. In the first place, we are to estimate in the aggregate, as a loss to the continent, what we have hitherto dwelt upon only as the suffering of individuals: and in this calculation must be included the withdrawal of about two hundred millions of population. This population has generally been selected, from obvious motives of policy, as the stoutest and most capable of labor.

In the second place, we must bear in mind the slaughter, starvation, and every other kind of misery produced in the tribes on the coast, in their own country. Take for example Calabar, a noted slave-station already mentioned as the site of an infamous transaction. At one time during the last century, the captains of several vessels lying off there, thinking that the natives asked too much for their slaves, held a consultation, how they should proceed; and agreed to fire upon the town unless their own terms were complied with. On a certain evening they notified their determination to the traders; and told them, that, if they continued obstinate, they would put it into execution the next morning. In this they kept their word. They brought sixtysix guns to bear upon the town; and fired on it for three hours. Not a shot was returned. A canoe then went off to offer terms of accommodation. The parties however not agreeing, the firing recommenced; more damage was done; and the natives were forced into submission. There were no certain accounts of their loss. Report said that fifty were killed; but some were seen lying badly wounded, and others in the agonies of death, by those who went afterwards on shore.

To illustrate the extent to which the natives have been continually exposed to violence and captivity, we give a small part of the evidence of Mr Falconbridge to the British Parliament, relating to the time during which he was agent of the company of Sierra Leone, and resident at that Colony: —

"Sitting one evening near his house, he heard a shout and immediately afterwards the report of a gun. Fearing an attack, he armed forty of the settlers, rushed with them to the place from whence the noise came. He

found a poor wretch, who had been crossing from a neighboring village in possession of a party of kidnappers who were tying his hands. Mr Falconbridge, however, dared not rescue him lest, in the defenceless state of his own town, retaliation might be made upon him.

"At another time a young woman, living half a mile off, was sold, without any criminal charge, to one of the slave ships. She was well acquainted with the agent's wife, and had been with her only the day before. Her cries were heard, but it was impossible to relieve her.

"At another time a young lad, one of the free settlers who went from England, was caught by a neighboring chief, as he was straggling alone from home, and sold for a slave. The pretext was that some one in the town of Sierra Leone had commited an offence. Hence the first person belonging to it who could be seized, was to be punished. Happily the free settlers saw him in his chains; and they recovered him, before he was conveyed to the ship." * *

"He would mention one other instance. A son had sold his own father, for whom he obtained a considerable price: for as the father was rich in domestic slaves, it was not doubted that he would offer largely for his ransom. The old man accordingly gave twentytwo of these in exchange for himself. The rest, however, being from that time filled with apprehensions of being on some ground or other sold to the slave ships, fled to the mountains of Sierra Leone, where they now drag on a miserable existence. The son himself was sold, in his turn, soon after."

The effects of a system like this on the character and condition of the natives, is a branch of our subject which from its vast importance would require a much more elaborate notice than our space will admit, were not the considerations in question so obvious to the common sense and reflection of every reader. The coast of Western Africa has at length become nearly depopulated, for a distance of thousands of miles, under the inflictions or the fear of this horrible traffic. A tract of country, the most beautiful and fertile in the world, abounding with rivers, and capable of sustaining countless millions of men in

abundance and happiness, and of carrying on a vast commerce with the rest of the world, now bears the appearance only of an immense wilderness, overgrown and overshadowed with the luxurious ruin of nature. Traces of ancient villages are everywhere discoverable, but the sites are as universally desolate at the present time. The tribes named heretofore as residents in Western Africa are the *nearest* to the Coast, but few reside nearer than twenty or thirty miles.

Again, the unhappy negroes have become infinitely more subject to all sorts of imposition, oppression and outrage, from each other and from their rulers, in consequence of the slave-trade. The example of morals set before them, in general, by foreigners, and the provocation offered *directly*, could hardly be expected to exercise a happy influence over their dispositions; but the positive temptations held out to barbarous avarice, ambition and revenge, and almost every other bad passion, have produced the most fatal results. Family has been set against family, and tribe against tribe. Sovereigns have waged unprincipled and unprovoked war with each other, for the sake of making captives; and have put in execution every device of accusation, artifice and even absolute force, among their own subjects, whereby the same all-engrossing end might be effected. The most terrible despotism in some cases, the most savage anarchy in others, and a frightful destitution and even dread of social and civil order in all, have been the distinguishing marks of the slave-trade, left,— like the traces of a vast inundation of chaotic waters, — along the entire length of the Western Shore.

The proper REMEDIES for this enormous evil have already been referred to in our Tract upon the NIGER. 1. Every civilized nation concerned in the traffic should follow the example of this country and Great Britain, to the full extent, in declaring it PIRACY, and in taking the most vigorous measures for an effectual execution of the law. As it is, vast numbers of traders conceal themselves under the guise of flags and papers not yet interdicted; and a sort of sanction is given to the business itself in the sufferance, if not cordial support and main-

tenance of it, by nations of no inconsiderable rank and power.

2. A system of stations, cruisers, prize-courts, and other measures suitable fully to execute what we have already said has been decreed. England has done much in this way, against many obstacles and much opposition. Our own country has done something. But there seems to be no good reason, why a number of our sloops of war, or perhaps national vessels fitted purposely for the business, should not be sent to reconnoitre, guard and protect the coast, and especially the mouths of the rivers. Heretofore a place of refreshment and repair has been needed, answering to the English Colony at Sierra Leone; but since the establishment and unexampled growth and prosperity of Liberia, that deficiency no longer exists. Liberia itself has done much to suppress the traffic on its own boundary, and it will undoubtedly do much more.

3. The CIVILIZATION of the NATIVES. This, after all, must be the ultimate cure of the evil, and every antidote less than that can be but temporary and partial. Civilization must be a slow process, but it may be sure, and it cannot fail to be decisive. Let as much of the coast as possible be occupied by legitimate colonies. Let the residue, including the rivers, be vigilantly beset with cruisers and batteries. Let the natives be universally and kindly invited to a social intercourse, and to an honorable and profitable commerce. Let a good example be held before them, — their wrongs redressed,— their rights protected, — instruction liberally dispensed by proper agents,— and especially a complete *assurance* impressed upon them of the absolute suppression of the all-devouring, discouraging, disgusting, abominable SLAVE-TRADE.

We have alluded to the establishment of the Liberian Colony on the Western Coast. The influence which that settlement and other settlements of a similar character have had, and may reasonably be expected to have on the slave-trade, is a matter of too much moment not to receive a more distinct and particular notice.

The truth is, that no system could possibly be devised better calculated than a colonial system of this kind, —

properly supported by this and other countries, and according to their several rights and interests,—to promote the speedy, and what is much more to be considered, the radical correction of the evil. To perceive the soundness of this remark, it is only necessary to bear in mind the facts already introduced in relation to the subject in the preceding pages and the inferences which closely attach to them

Two principles may be considered fixed. The slave-trade cannot be suppressed without the civilization of the natives; and the natives cannot be civilized without the suppression of the slave-trade. These two great objects, then, must be promoted together. The strong arm of justice on the coast must be exercised to keep off the temptation, violence, fraud, evil example, and the horrible influence of a deadly prejudice against the whites in the minds of the Africans, in order that the ordinary process of instruction and intercourse, and the benefits of a sound commerce, may be brought to affect them favorably at all; and it is just as true, on the other hand, that this same process of instruction must be brought to bear upon them to some considerable extent, in order that their confidence and active coöperation may be secured against the trade and the traders.

Now let us consider what are the advantages, in either of these points of view or in both, to be expected from the establishment of colonies like the Liberian. In the first place, then, they afford, and will afford, stations of refreshment, recruiting and repair for the American commerce and navy as well as for those of other nations. They would be highly desirable to supply and support a cruising-system upon any coast; but in the case of a coast and especially a climate like that in question, they are absolutely indispensable, and the more of them the better. This cruising system itself, too, is equally indispensable under present circumstances, and will be for some time to come, to the security and peace of the western shores. Were it only for the protection of the commerce already plying between that continent and this, and still more for the promotion and encouragement of it in future, the American Government would consult its own interest and

honor by maintaining a vigilant naval police in this quarter. Even merchant-vessels are by no means safe from the piracy of the traders, though most of the former go armed much more substantially than they would be by the terrors of the law alone. It is but about a year since the Montserado, a schooner belonging to the American colony, was captured by a Spanish pirate off Cape Mount, (*now* a part of the Colonial territory, though not *then*,) and her crew, consisting of eight persons, either conveyed away on board the Spanish vessel, or put to death on the spot. Not long before, two English ships in the Bight of Benin had been taken by pirates, and treated in the same manner. Other cases of the same character have occurred more recently, and yet it is altogether likely that not one case in five is ever distinctly ascertained.

Indeed, to do justice to our own Government, their attention has already been directed to this subject. The Managers of the Colonization Society stated in their Fifteenth Annual Report, for January last, that the Secretary of the Navy had declared himself in favor of a plan of police such as they recommended. In the same document also may be seen a letter to the Society from the venerable Chief Justice of the United States, in which is the following passage : —

" It is undoubtedly of great importance to retain the countenance and protection of the American Government. Some of our cruisers, stationed on the coast of Africa would, at the same time, interrupt the slave-trade — a horrid traffic, detested by all good men — and would protect the vessels and commerce of the Colony from pirates who infest those seas." Since this was written, we believe that one or more national vessels have been ordered out to the African coast, and there can be little doubt that such a measure will be of equal service to the Africans, the Liberians, and the mercantile citizens of this country. The subject assumes much greater moment, when we consider that there is every reason to believe, that the commerce between that country and this will increase as the settlements increase, and that it may be made at no very distant period a source of large emolument to ourselves, and of still greater benefit to the Africans. To

induce them to assume agricultural habits, and then to maintain a safe, certain and constant mercantile communication with them, would be gaining two points of perhaps conclusive effect on both the civilization of the natives and the suppression of the slave-trade: neither of these points *can* be gained without the aid of a vigilant national police on the coast, in the first instance; and that system cannot be supported, whether it be Liberian or American, without forts, trading-houses, colonists acclimated, a thorough acquaintance with the geography of the shores, and abundant opportunities to recruit, refresh and repair.

But whatever may be effected in this way, it is at least clear, that the actual occupation of so much of the coast as belongs and can be lawfully attached to the colonial jurisdiction, will be an almost infallible correction of the evil so far as it has existed within these boundaries. Now, the Liberian Colony has already acquired a right to a line of the coast extending nearly three hundred miles in one direction. This has been effected by peaceable means, and with comparatively slight funds. England owns and occupies also another large tract, a few degrees north of ours, called the Colony of Sierra Leone. Both these governments have effectually banished the trade from their own precincts, besides taking active measures for its suppression in other quarters. And why may not the system be extended till it embrace the greater part of the exposed shore? — especially as the native owners have quite generally retreated into the interior, and left the maritime districts unoccupied and without a claimant. As an instance in point, it may be observed that the Gallinas, between the American and the English Colonies, now belongs to the former, and has of course been subjected to a careful supervision. This has heretofore been a trading or kidnapping station of such an order, that only two years since no less than nine hundred slaves were shipped there in the space of only three weeks.

In regard to this view of the influence of the Colony on the Trade, both by occupation and by cruising, — each of which is essential to the complete success of the other,— we shall add a single passage from the Fourteenth Report of the Colonization Society: —

"The Managers beg leave here to repeat the opinion of the late Dr Randall, which was expressed in their last Report, 'that the effectual method for breaking up this traffic, would be to send upon the coast, light, well-armed and fast-sailing schooners, which might touch at those places whence the slaves are taken, and which should relieve each other and remain upon the coast the whole year: they should be accompanied by one or two sloops of war, with a force sufficient to break up the Slave Factories.' The Managers are persuaded that no subject, more than this, demands the earnest and immediate attention of all humane and conscientious Statesmen, and of all the friends of mankind."

One instance, of quite recent date, an account of which is given by an English paper, will be sufficient to illustrate the general reasoning of the managers: —

"The Fair Rosamond and the Black Joke, tenders to the Dryad frigate, have captured three slave vessels, which had originally 1800 slaves on board, but of which they succeeded in taking only 306 to Sierra Leone. It appears the Fair Rosamond had captured a lugger, with 106 Africans, and shortly afterwards saw the Black Joke in chase of two other luggers; she joined in the pursuit, but the vessels succeeded in getting into the Bonny River, and landed 600 slaves before the tenders could take possession of them. They found on board only 200, but ascertained that the rascals in command of the slavers had thrown overboard 180 slaves, manacled together, four of whom only were picked up."

What we have already said refers exclusively to the external and forcible influence of a colonial system. That which refers to the civilization of the neighboring Africans is of at least equal importance. There is no plan, perhaps, so well adapted to effect this most desirable object as Colonization. This leads or should lead, in the first instance, to a thorough, cordial, cheerful acquaintance and intercourse with the natives. Their confidence is won by kindness; their respect is gained by good example and superior knowledge and power; and a perfect knowledge of their talent, disposition, wants and prejudices is acquired. Then missionaries and teachers

may perhaps be sent among them to advantage; but at all events, a free communication is opened between the civilized party and the barbarous neighbor. The latter is glad to be instructed, and proud to imitate. The African is proverbially docile, simple-minded, sociable, and especially fond of traffic and novelty. Add to these circumstances that he generally respects the white man as a more favored being than himself, and the prospect is complete. And just such it is in the case of Liberia and its neighbors, *in fact*. The chiefs are almost universally desirous of being taught, and of having schools established among their people; and the people themselves are not less anxious to learn, to adopt the habits and customs of the colonists, and to become, as they say, "*Americans*." In several instances the kings have sent their sons into Liberia, with an urgent request that they might be educated. In fine, the more the colonial system is extended, if it be but suitably maintained, the more certain and the more speedy becomes, every year and every day, the civilization of Africa and the suppression of the slave-trade. Not till then can the resources of that vast continent be developed. Not till then can the sullied honor of Christendom be redeemed from the foulest stain which all history has recorded.

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SCIENTIFIC TRACTS.

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SCIENTIFIC TRACTS.

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THE ELEPHANT.

The animals of civilized countries, long dependent on man for their support and existence, have at last lost almost all their natural intelligence. The horse, which we see stupid, humble and obedient, in the state of nature is cunning, courageous and powerful, capable of defending himself against his numerous enemies. The lion, the tiger, and the jaguar, which defy the power of man, and which often pursue him to his dwelling, dread the approach of an animal that fights in society, and which makes no attack but with an advantage which secures him an easy victory. The ox and sheep, under the power of man, lose nearly every glimmering of knowledge, and seem to be guided only by their immediate desires and fears; their bodies are clumsy, unwieldy, and suited for no condition, but that of slavery.. In their wild state, these animals are fleet and sagacious; they foresee distant danger, and well know how to avoid it; and if necessity forces them to defend themselves, they fight in company, lend each other mutual assistance, and seldom fail to destroy their enemies, or put them to flight. The beaver in the wilderness distant from civilized beings, is possessed of intelligence approaching that of man; he constructs himself a habitation, in a manner that would do honor to human ingenuity, if mankind had the same necessities as himself; and he not only has the language of nature, common to all animated beings, by which their pleasures, pains and desires are made known; but seems to possess the art of communicating such information to his comrades,

that has led some to suppose that he was not devoid of the power of speech, or at least, that he enjoyed it in an inferior degree. Nevertheless, this wonderful creature, in inhabited countries, becomes stupid, and barely retains sufficient skill to enable him to excavate a hole for the place of his abode.

Animals, like men, when they are wholly in the power of rapacious enemies, merely seek to preserve their present existence. When forced for a long period to obey the commands of others, they lose the power of conducting themselves, and either implicitly obey the mandates of their masters, the reason of which they cannot understand, or by their vain and unskilful opposition, show the depth of degradation to which they have sunk.

In order to discover them in all their native superiority, we must travel to the most thinly inhabited countries, where savage man rises but little above the beasts in intellect. Here we find animals of varied form and magnitude: some of the species in civilized countries appear to have been taken under the protection of man, and others have been destroyed by him in an unequal contest for superiority.

In the uninhabited regions of the torrid zone, nature seems to have sported with her productions: vegetables grow to an enormous size; insects of almost all imaginable shapes, and often of a magnitude sufficient to astonish us, swarm in the air; the crocodile and hippopotamus hold undisturbed possession of the rivers; the liboya and other serpents of immense size, glide swiftly through the meadows and tangled groves; the lion and tiger lie in the thicket, ready to dart on whatever animal comes within their reach, and the rhinoceros and elephant move their huge bulks through the forests.

The last mentioned animal has in all times been regarded as one of the noblest of the productions of nature. Though his body appears shapeless and ungainly, and would seem to indicate the greatest stupidity, yet the elephant, in sagacity, perhaps of all other animals approaches man the nearest. It is true that he does not construct himself a habitation, like the beaver and some other creatures; but we must not conclude from this, that he is

naturally inferior to them. All animals practise such arts as their necessities compel them to adopt, and the elephant, which delights to roam in the dark forests, and prefers sleeping in the open air, has no desire to construct a thing for which he can have no possible occasion.

If we take a hasty view of quadrupeds, we are induced to believe that their anatomy, or structure, is very different from that of man, but the diversity is more imaginary than real. If our description of the structure of the human subject, in the tract on Temperaments, is kept in mind, and if we suppose him mounted on all-fours, we shall have a tolerable idea of the formation, and position of a quadruped. Differences between its anatomy and that of man there certainly are; but these consist more in the diverse proportion of the parts, than in the existence of anything in the one which is not common to the other.

In quadrupeds, the vertical diameter of the body is greater than the horizontal: for this reason, what in man is called the shoulder blade, instead of lying on the back, as in the human subject, is on the side of the animal, and the rest of the fore leg forms with it a straight line. As a consequence of this construction, and of the want of collar-bones (which is pretty general,) the muscles which connect the upper part of the fore leg to the ribs are so arranged, that nearly all the lateral motions of these limbs are effectually prevented. This is particularly the case with the elephant, which, in order to wheel about, is obliged to make a large circuit. The lion and tiger are therefore generally able to spring upon his flanks, when they attack him, which commonly proves fatal, unless several are found in company.

At the nape of the neck in quadrupeds, there is a strong thick muscle, which serves to keep the head in the proper position, and which is wanting in man, or at least is very small. This muscle is one of the strongest in their bodies, since the head is generally situated at some distance in front, and the sinew, instead of pulling its weight directly upwards, acts very obliquely. It is of enormous strength in the elephant, whose head is very heavy, and whose tusks alone have been found to weigh more than five hundred pounds. As the back bone or spine in

quadrupeds, is subjected to a great lateral strain in supporting their bodies, we find, as we might naturally suppose, that it is much stronger than in man, in whom the spine acts as a pillar in supporting the weight of the body. In order that it may be still better able to resist the power which continually acts upon it, the small bunches (*spinal processes*,) which are found on the back part of each joint of the spine in the human subject, are lengthened out in quadrupeds into long thin bones, which (as well as the joints of the back bone,) are connected by numerous muscles to one another, and to the bones of the head, &c. The spine being constructed in this manner, is very firm : but the weight of the body in most animals is so great, as to cause it to bend downwards in such a manner, that luxations are prevented merely by the strength with which the several joints are connected. In the elephant, as the body is enormously heavy, the spine is not only fortified in the manner of which we have spoken, but is arched; so that when it is put to an uncommon strain, the parts, instead of tending to separate, are only brought into closer contact.

Although the form of many quadrupeds appears more like that of man than the elephant's, yet the structure of few resembles that of the human race so much as his. The hind leg of the elephant has the same number of joints as the leg in man, and is shaped in an analogous manner; so that the animal kneels on his hind legs (as well as on the fore ones,) which is not the case with other quadrupeds; the udder of the female is divided into two parts, and is situated near the fore legs; and his feet have five toes each. These toes are usually terminated by five nails, though not always, and sometimes twenty nails are seen on a foot : however, the number of toes are always found the same on dissection, which shows us an example of the many we observe, in which nature appears irregular without being so in fact.

The elephant is furnished with a tail of no great length, which is terminated by a tuft of hair so coarse that it resembles strips of horn. His body is on all sides covered with a thick rough hide, of an ashy brown color, with a few straggling hairs in the seams or wrinkles.

The skin of animals is known to be composed of three layers, which are generally very closely connected with each other: but the outermost or scarf skin in the elephant is so loosely attached to the next interior one, that the sun and air dries and wrinkles it up, and produces the disorder of the skin, called the elephantiasis or leprosy. This disorder being general on all parts of the body, the sense of feeling must be almost null, except in the furrows of the wrinkles, where he can perceive the presence of the smallest insect. The uncomfortable sensation which he experiences from his dry and parched hide, gives him a disposition to bathe, to wallow in the mire, and to brush himself with the branches of trees. He delights to be rubbed with oil, which renders his skin soft and pliant.

The sagacity of animals seems to depend in no small degree on the perfection of their external senses, and especially on the delicacy of the sense of feeling. At the first glance, we might naturally suppose, that the elephant, whose body is wrapped up in such an envelope as we have described, could have but an imperfect knowledge of the surface of bodies: but the trunk or proboscis with which he is furnished, amply compensates for the deficiencies of the rest of his body.

This organ proceeds from the upper jaw like the snout of a hog, and gradually tapers to the distance of six or seven feet, where it suddenly ends. At its extremity it is one of the most sensitive organs in nature; on the upper side there is a small protuberance, which has been sometimes called the finger of the elephant, and directly opposite, the under side projects a little, and with the finger performs the office of thumb.

The sense of touch in the end of the proboscis is so extremely nice, that he easily picks up a fourpence or a pin from the sand. The strength of the trunk is at the same time so great, that he easily uproots trees of considerable size by its means. It is penetrated throughout its whole length by two canals which lie side by side: those cavities are the nostrils through which he breathes; they contract near their termination at the head, where he has the power of shutting them entirely.

The trunk is chiefly composed of distinct muscles moving in cellular membrane in almost every imaginable direction. Some pass lengthwise, others crosswise, some encircle the trunk, and others again run spirally from one extremity to the other. The contraction of these muscles, that are known to be nearly forty thousand in number, each of which has the power of distinct action, is sufficient to give the trunk motion in every direction: he can diminish its length and size, and thrust it out at pleasure.

With this instrument he collects his food, and carries it to his mouth. If he wishes to raise a small object like an apple, he grasps it between his thumb and finger; when he eats a quantity of grass, he twists his trunk about a lock, and tearing it off, places it between his grinders; when he raises something which he cannot embrace with his trunk, as a flat stone, he applies to it the extremity of his proboscis, and drawing his breath, lifts it, as a boy does an inkstand with his lips. In drinking, he places his trunk in the water, sucks into its cavities as much as he pleases, and by contracting the upper part, shuts the two canals, when turning it into his mouth, he opens the entrance to the two cavities, and ejecting his breath, forces the water down his throat.

Many naturalists have wondered why the elephant should be able to draw water into his trunk by the action of his breath, and at the same time to expire the breath from the mouth: but this circumstance is perhaps not more astonishing than the power which we possess of holding an inkstand or vial at our lips by suction, and to continue breathing. The elephant can also throw a liquid from his trunk to a considerable distance, as a boy spirts water from his mouth; and he often makes use of this power to insult those that he dislikes, by casting on them a torrent of muddy water.

His sense of smelling is also so exquisite that he can discover the scent of a tiger, hog or other animal, which offends him, at a great distance. The organ of this sense, which is situated near the upper extremity of the trunk, on dissection, is found to have a great expansion, and a very complicated structure.

The eyes of the elephant are exceedingly small, compared with his magnitude, being no larger than those of an ox; but notwithstanding their size, he is remarkably sharp sighted, though he is not able to perceive distinctly an object directly over him, since from the thickness of his neck, his head cannot be raised as much as in most other animals. This circumstance might appear to us a great deficiency, if we did not observe that the power of looking upwards, would be of no great service to him. The nicety of the senses of smell and touch, are so great, that he easily discovers with his trunk, the fruit, or whatever else is situated above him within his reach. The eye is furnished with a thin broad muscle, which lies in one corner, and which the animal has the power of drawing completely over it, so that he can by means of this curious appendage clear this organ of leaves, broken pieces of wood, sand or insects; his broad pendant ears he can also flap over his eyes, and protect them from the danger of falling branches.

The internal ear is admirably fitted for the perfection of the sense of hearing. It is well known that the sensation of sound is caused by the vibrations of the air striking on a great muscular bag, called the drum of the ear. This organ is much larger in the elephant in proportion to his size than in most other animals, and is constructed in a peculiar manner.

From each side of the upper jaw, a monstrous tusk proceeds, and bending upwards and tapering, terminates in a point at a distance generally of three or four feet. He has no cutting teeth and but two grinders in each jaw.

The ordinary dimensions of the enormous animal which we are considering, are eight or nine feet in height, thirteen or fourteen in length; and his weight is five or six thousand pounds. But neither the greatness of his bulk, the acuteness of his senses, nor the exact adaptation of all parts of his body to his peculiar wants, are capable of causing the admiration which the intelligent principle that resides in the huge mass excites. As he lives wholly on vegetables he attacks none of the inferior animals without provocation. When he is once

roused, he seizes the offender with his trunk, and dashes him to the earth, tosses him into the air with his tusks, or receives him on their points, and transfixes him in an instant.

The elephant has been taken from his native wilds, and forced under the control of man from the earliest ages; formerly he was employed in wars, and every Eastern army was accompanied with a train of elephants: but they always lent a precarious assistance, and not unfrequently caused as much damage to their own army as to that of the enemy. At present, they are employed in the wars of the East merely as beasts of burden.

When tamed, he is in general one of the most docile animals in nature, and constantly exerts himself for the pleasnre of his master: but he must be treated gently, as he easily discovers when an injury or insult is intended, and seldom fails to take revenge. We have several accounts of elephants which have killed their drivers for being struck without reason. "As an embassy was proceeding from the vizier of Oude to Lord Cornwallis at Calcutta, a large male elephant, that was violently struck by his driver, was so irritated that he instantly seized the unfortunate Indian with his trunk, dashed him to the earth, and killed him."* I well recollect a circumstance of the same nature, which occurred several years ago at an exhibition of animals. A man in the crowd offered an elephant a piece of tobacco, which he had chewed, in place of a slice of gingerbread or an apple, which he had often received from the bystanders; the elephant instantly distinguishing him from the others, seized and crushed him to the earth with his trunk and tusks, breaking both bones of one of his legs.

The elephant, however, is not usually prompted to take immediate vengeance on those that injure or insult him, if it is probable that he shall have an opportunity afterwards. He appears to meditate how he shall revenge himself most suitably to the offence given, and waits patiently for the most convenient season. In Williamson's Oriental Field Sports, we are told an amus-

* Library of Entertaining Knowledge.

ing story of an elephant, which was employed in the British army to transport baggage. He was called The Fool from his stupidity. This animal once refused to carry a greater weight than he chose, and pulled part of it from his back, repeating the operation as often as it was replaced. A brigade quarter-master, irritated at his obstinacy, threw a tent pin at his head. A few days after, as the elephant was going from the camp to the water, he overtook the quarter-master, and taking him up, very politely placed him in the top of a large tamarind tree, leaving him to hold on to the branches, and to get down in the best manner that he could.

Lieut. John Shipp in his memoirs, tells us, that in order to discover how long the elephant could remember an insult, he gave one a large quantity of cayenne pepper in some bread. About six weeks afterwards, he endeavored to "scrape acquaintance" with the animal: but after caressing it some time, the elephant all the while behaving in a very docile manner, in consideration of Shipp's former present, gave him as an equivalent, a complete drenching with dirty water from head to foot.

The elephant sometimes revenges himself in a ludicrous manner, and not unfrequently in a way exactly adapted to the offence. We ought not to be surprised that he should resent an insult or injury at the time of its being offered, as other animals do this, but that he should take his revenge at a period distant from the time in which the action that displeased him was committed, and in a manner which he appears to have premeditated, is certainly wonderful.

As he recollects an affront during a long period, and is ever ready to punish the offender, so a benefit is remembered equally long, and his gratitude is shown on all proper occasions. We have all heard the story of the intoxicated soldier, who having done various acts of kindness to an elephant, was protected by him under his belly from the attempts of his comrades to seize him; and there are several authentic accounts of elephants, which have died from an excess of grief, occasioned by the death of their masters, who had been slain, or whom they had killed in a sudden fit of rage.

It must not be supposed that every elephant is the same noble magnanimous creature, as is usually described, nor indeed that any one is always consistent in his actions. Writers in treating of this animal, seem to wish to portray a bettor character than he really possesses. He is said to be brave, serious and sedate ; all his good qualities are enumerated, and his bad ones are mentioned only by chance. Some of the ancients even thought that he believed in the existence of a Deity, and paid his adoration to the sun.

Nevertheless, if we consider his true character, we shall find sufficient to admire in this noble animal. One of the most surprising proofs of his sagacity, is that ability with which he performs any duty when left to himself. We have accounts well authenticated of elephants which are employed without any overseer to pile wood in a regular heap. It is said that they place the pieces of wood upon each other in much the same manner as a man, and then standing aside, observe whether the pile is perpendicular or not.

An officer who served in India says: "I myself have seen the wife of a driver give a baby in charge to an elephant, while she went on some business, and have been highly amused in observing the sagacity, and care of the unwieldly nurse. The infant, who like most children, did not like to lie still in one position, would as soon as left to itself begin crawling about. By this means the child would sometimes find its way among the legs of the animal, or get entangled in the branches on which he was feeding. In such a case he would in the most tender manner disengage his charge, either by lifting it out of the way with his trunk, or by removing the impediments to its free progress. If the child had crawled to such a distance as to verge upon the limits of the animal's range (for he was chained by the leg to a peg driven into the ground,) he would stretch out his trunk, and take it back again as gently as possible to the spot whence it had started."* D'Obsonville relates that he "saw two elephants occupied in beating down a wall, which they had been com-

* Library of Entertaining Knowledge.

manded to do by their keepers. They combined their efforts, and doubling up their trunks, which were guarded from injury by leather, pushed against the strongest part of the wall; and by repeated shocks continued their attacks, still observing and following the effect of the equilibrium with their eyes, when at last making one grand effort, they suddenly drew back together, that they might not be wounded by the ruins."

"In 1811, a lady who related the circumstance to us, staying with her husband, an officer in the East India Company's service, at a house near the fort of Travancore, was astonished early one morning to observe an elephant, unattended, marching into the court yard, carrying a box with his trunk, apparently very heavy. He deposited this, and soon returned with a similar box, which he placed by the side of the other and continued this operation till he had formed a considerable pile, arranged with undeviating order. The boxes contained the treasure of the Rajah of Trauvancore, who had died during the night, of whose property the English commander had taken possession, removing what was most valuable for greater security."*

These animals often show a deep sympathy for the sufferings of one another, and of the human race, which has been shown in many remarkable instances.

Bishop Heber tells of an old starved elephant, which having fallen down, another, of a very large size and in somewhat better condition, was brought to assist. "I was much struck," says he, "with the almost human expression of surprise, alarm, and perplexity in his countenance, when he approached the fallen sufferer. They fastened a chain around his neck, and the body of the sick beast, and urged him in all ways, by encouragement and blows, to drag him up. They even thrust spears into his flanks. He pulled stoutly for a minute; but on the first groan his companion gave, he stopped short, turned fiercely round with a loud roar, and by means of his trunk and fore feet, attempted to loosen the chain from his neck."

"The Baron of Lauriston, being at Lacknaor at the time

* Library of Entertaining Knowledge.

an epidemic distemper was raging, and when the road to the palace of the Nabob was covered with the sick and dying, states, that as the Nabob rode out one day on his elephant, the slaves made no effort to clear the road, leaving their fellow creatures to be trodden on by the animal; but that the more charitable beast without any command, lifted some out of his way with his trunk, and stepped so carefully among the rest, that none were hurt."

"The train of battering artillery going to the siege of Seringapatam, had to cross the sandy bed of a river, that resembled other streams of the Peninsula, which leave during the dry season but a small brook running through their beds, but are mostly of considerable breadth. Their channels abound with quicksands, and are very heavy for draught. It happened that an artillery man, who was seated on the tumbril of one of the guns, by some accident fell off when crossing one of these places in such a situation, that in a second or two the hind wheel must have gone over him. The elephant which marched behind the gun, seeing the man's critical situation, instantly without any warning lifted up the wheel with his trunk, and kept it suspended till the carriage had passed clear of him."*

These examples are sufficient to show the great sagacity of the animal, and to place him perhaps above all the rest of the brute creation. The enormous mass of flesh and bone which seems almost incapable of motion, is animated by an intelligence which is second only to that of man.

We cannot forbear giving another anecdote tending to show his knowledge and docility. "At the siege of Bhurtpore in the year 1825, the British army, with its countless host of followers and attendants, and thousands of cattle, had been a long time before the city, when on the approach of the warm season, and of the dry hot winds, the quantity of water in the neighborhood of the camp necessary for the supply of so many beings, began to fail; the ponds and tanks were dried up, and no more water was left than the innumerable wells of the country

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could afford. The multitude of men and cattle that were unceasingly at the wells, particularly at the largest, occasioned no small struggle for priority in procuring the supply which was necessary for each; and consequently a considerable confusion often occurred. On one occasion two elephant drivers, each with his elephant, the one remarkably large and strong, and the other comparatively small and weak, were at the well together. The small elephant had been provided by its master with a bucket, which he carried at the end of his proboscis; but the larger animal being destitute of this necessary vessel, either with his own accord, or by the desire of his driver, seized the bucket, and easily wrested it away from his less powerful fellow servant. The latter was too sensible of his inferiority, openly to resent the insult, though it is obvious he felt it; but great squabbling and abuse followed among the drivers.

"At length the weaker animal, watching the opportunity when the other was standing with his side to the well, retired backwards in a very quiet and unsuspicious manner, and then rushing forward with all his might, drove his head against the side of the other, and fairly pushed him into the well. It may be easily imagined that great inconvenience was immediately experienced, and serious apprehensions quickly followed, that the water in the well, on which the existence of so many seemed in a great measure to depend, would be spoiled or at least injured by the unwieldy brute, that was precipitated into its cavity. As the surface of the water was nearly twenty feet below the level of the ground around it, there did not appear to be any means which could be adopted to get the animal out by main force: at least without injuring him. There were many feet of water below the elephant, which floated with ease on its surface: and experiencing considerable pleasure from his cool situation, evinced but little inclination, even to exert what means he might possess in himself of escape.

"A vast number of fascines had been employed by the army in conducting the siege, and it at length occurred to the elephant driver, that a sufficient number of these (which may be compared to bundles of wood) might be

lowered into the well to make a pile, which might be raised to the top, if the animal could be instructed in the manner of placing them in regular succession under his feet. Permission having been obtained from the engineer officers to use the fascines, the driver had to teach the elephant the lesson ; which by means of the extraordinary ascendency that those men attain over the elephant, joined to the intellectual resources of the animal itself, he was soon enabled to do : and the elephant began quickly to place each fascine as it was lowered to him, sucessively under his feet, until in a short time he was able to stand upon them.

"By this time the cunning brute, enjoying the pleasure of his situation, after the heat and partial privation of water to which he had been lately exposed, was unwilling to work any longer; and all the threats of his master, could not induce him to lay another fascine. The man then opposed cunning to cunning, and began to caress and praise the elephant, and what he could not obtain by threats, he was enabled to do by the repeated promises of plenty of rack, a spirituous liquor of which he is fond. Incited by this, the animal again set about his work, and raised himself considerably higher, until by a partial removal of the masonry around the top of the well, he at length stepped out; after having been in such a ludicrous situation nearly fourteen hours."*

The elephant under the power and guidance of man, we must also always keep in mind is by no means the same as in the state of nature. There he roams at liberty, disturbed only by the want of supplying his necessities, and of defending himself against his numerous enemies. His wants, however, are not few nor easily supplied; he consumes regularly two hundred pounds of aliment every day ;* and it requires some degree of penetration to choose that part of the forest where sufficient quantity of his proper food can be obtained : the more so as he must drink and bathe frequently, which in the dry season can be done in but few places. A quagmire, a quicksand, and numerous other things with which his

* Library of Entertaining Knowledge.

native wilderness abounds, would be fatal to such a heavy unwieldy animal as the elephant, if he did not continually exert his cunning to shun them. As he is unceasingly obliged to be on his guard in his wild state against dangers like these, afterwards, when he is forced into slavery, he is always distrustful of the support on which he is placed; he examines it with his trunk, strikes it with his feet, and then ventures upon it with the greatest caution. An anecdote related in the Library of Entertaining Knowledge exemplifies in an extraordinary manner, his power of discerning when the fastening is unsafe.

"An elephant belonging to Mr Boddom of the Bengal service at Gyah, was accustomed every day to pass over a small bridge, leading from his master's house into the town. He one day refused to go over it, and it was with great difficulty by goading him most cruelly with the goad, that the driver could make him venture on the bridge, the strength of which he first tried with his trunk, showing clearly that he suspected that it was not sufficiently strong. At last he went on, and before he could get over, the bridge gave way, and they were precipitated into the ditch, which killed the driver, and considerably injured the elephant."*

We have said that this animal is by no means in the state of nature, as in that of slavery: in the one case necessity obliges him to put in requisition all his faculties to provide himself with food, defend himself against his enemies, avoid dangerous situations, and choose such places for his habitation, as will enable him to live at the greatest ease and pleasure; his cunning and sagacity are every day improving by continual exercise, and his knowledge is constantly increasing by experience. But when he is taken under the protection of man, food and protection are furnished for him; he has occasion to exert his sagacity, only in obeying the commands of his master; his faculties by not being employed must consequently be impaired. When therefore he spontaneously performs some surprising feat, it must be regarded as the more extraordinary. One of the most astonishing things

* Library of Entertaining Knowledge.

concerning these animals is, their disposition to assist another in distress, which few others are known to attempt.

Mr Pringle states that a few days before his arrival at Enon, "a troop of elephants came down one dark and rainy night close to the outskirts of the village. The missionaries heard them bellowing and making an extraordinary noise at the upper end of their orchard; but knowing well how dangerous it is to encounter these powerful animals in the night, they kept close within their houses till daylight. Next morning on their examining the spot where they had heard the elephants, they discovered the cause of all this nocturnal uproar. There was at this place a ditch or trench, about four or five feet in width, and nearly fourteen feet in depth, which the industrious missionaries had recently cut through the bank of the river, on purpose to lead out the water to irrigate some part of their garden ground, and to drive a corn mill. Into this trench, which was still unfinished, and without water, one of the elephants had evidently fallen, for the marks of his feet were distinctly visible at the bottom, as well as the impress of his huge body on the sides.

"How he got into this situation was not difficult to conjecture, but how, being once in, he had contrived to get out, was not so easy to conceive. By his own efforts it was obviously impossible for such an animal to have extricated himself. Could his comrades then have assisted him? There could be no question that they had; though by what means, unless by hauling him out with their trunks, it could not be imagined. In corroboration of this supposition, on examining the spot myself I found the edges of the bank deeply indented with numerous tracks, as if the other elephants had stationed themselves on either side, some of them kneeling, and others on their feet, and had then by united efforts, and probably after many failures, hoisted their unlucky companion out of the ditch."*

A story related by the celebrated traveller Bruce, further exemplifies this quality of the animal. In speaking

* Library of Entertaining Knowledge.

of an elephant hunt; after several were destroyed he says, "There now remained but two elephants of those that had been discovered, which were a female and a calf. The Agageers (men employed in such hunts to hamstring the animal) would willingly have let those alone, as the teeth of the female are very small, and the young one is of no sort of value, even for food, as its flesh shrinks much upon drying. But the hunters would not be limited in their sport.

"The people having discovered the place of retreat of the old one, thither we eagerly followed. She was very soon found, and as soon lamed by the Agageers: but when they came up to wound her with their darts, as every one did in turn, to our very great surprise, the young one, which had been suffered to escape unheeded and unpursued, came out of the thicket apparently in great anger, running upon the men and horses with all the violence possible. I was upon such an occasion affected at seeing the great affection of the little animal, which defended its wounded mother, careless of its own life or safety. I therefore cried to them for God's sake to spare the mother, though it was then too late. The calf made several rude attacks upon me, which I avoided without difficulty; and I am happy to this day in the reflection that I did not strike it. At last, making an assault upon one of the company, it hurt him a little in the leg, when he thrust it through with his lance, as others did after him; and it fell dead before its wounded mother, which it had so affectionately defended. Here," says Bruce, "is an example of a beast, a young one too, posessing abstract sentiments to a very high degree. By its flight on the first appearance of the hunters, it is plain that danger was apprehended to itself; it also reflected upon that of its mother, which was the cause of its return to her assistance."

I cannot refrain here from relating a very interesting description of an elephant hunt, in which the same quality of this extraordinary creature appears in a striking manner. The affair happened in South Africa, and the hero of the narrative was Lieut. J. D. Moodie.

"In the year 1821 I had joined the recently formed semi-military settlement of Fredericksburg, on the pictur-

esque banks of the Gaulana, beyond the Great Fish river. At this place our party, consisting chiefly of the disbanded officers and soldiers of the Royal African corps, had already shot many elephants, with which the country at that time abounded. The day previous to my adventure, I had witnessed an elephant hunt for the first time. On this occasion a large female had been killed after some hundred shots had been fired at her; the balls at first seemed to produce but little effect, but at length she received several shots in the trunk and eyes, which entirely disabled her from making resistance, or escaping; and she fell an easy prey to her assailants.

"On the following day, one of our servants came to inform us, that a large troop of elephants was in the neighborhood of the settlement, and that several of our people were already on the way to attack them. I instantly set off to join the hunters; but on account of losing my way in the jungle through which I had to proceed, I could not overtake them until after they had driven the elephants from their first station. After getting out of the jungle, I was proceeding through an open meadow on the banks of the Gualana, to the spot where I heard the firing, when I was suddenly warned of approaching danger, by loud cries of '*pas-op*' (look out), coupled with my name in Dutch and English, and at the same moment heard the crackling of broken branches, produced by the elephants bursting through the woods, and the tremendous screams of their wrathful voices resounding among the precipitous banks. Immediately a large female, accompanied by three others of a smaller size, issued from the edge of the jungle, which skirted the river margin. As they were not more than two hundred yards off, and were proceeding directly towards me, I had not much time to decide on my motions.

"Being alone and in the middle of a little open plain, I saw that I must inevitably be caught should I fire in this situation, and my shot not take effect. I therefore retreated hastily out of their direct path, thinking they would not observe me, until I should have a better opportunity to attack them. But in this I was mistaken: for on looking back I perceived to my dismay, that they had left their former course, and were rapidly pursuing,

and gaining ground on me. Under these circumstances, I determined to reserve my fire as a last resource, and turning off at right angles from their direction, I made for the banks of the small river, with a view to take refuge among the rocks on the other side, where I should have been safe.

"But before I had arrived within fifty paces of the river, the elephants were within twenty steps of me; the large female in the middle and the other three on either side of her, appearing as if they intended to make sure of me, all of them screaming so tremendously, that I was almost stunned with the noise. I immediately turned round, cocked my gun, and aimed at the head of the largest, the female. But the powder being damp, the gun blowed till I was in the act of taking it from my shoulder, when it went off, and the ball merely grazed the side of her head.

"Halting only for an instant, the animal again rushed furiously forward. I fell: I cannot say whether struck down by her trunk or not. She then made a thrust at me with her tusk. Luckily for me, she had but one, which still more fortunately missed its mark. She then caught me with her trunk by the middle, threw me beneath her fore feet, and thumped me about them for a short time. I was scarcely in a condition to compute the number of instants very accurately. Once she passed her foot on my chest with such force, that I actually felt the bones bending under the weight; and once she trod on the middle of my arm, which happily laid flat on the ground at the time.

"During this rough handling, however, I never entirely lost my recollection: else I have little doubt that she would have settled my accounts with this world. Owing to the roundness of her foot, I generally managed, by twisting my body and limbs, to escape her direct tread. While I was still undergoing this buffeting, Lieut. Chisholm and a Hottentot came up, and fired several shots at her, which wounded her in the shoulder, and at the same time her companions or young ones retiring, and screaming to her from the edge of the forest, she reluctantly left me, giving me a cuff or two with her hind feet in passing. I got up, picked up my gun, and stag-

gered away as fast as my aching bones would allow: but observing that she turned round and looked back towards me before entering the bushes, I laid down in the long grass, by which means I escaped her observation.

"On reaching the top of the high bank of the river, I met my brother, who had not been at this day's hunt, but had run out on being told by one of the men, that he had seen me killed. He was not a little surprised at meeting me alone, and in a whole skin, though plastered with mud from head to foot. While he, Mr Knight of the Cape regiment, and myself, were yet talking of this adventure, an unlucky soldier by the name of M'Clane, attracted the attention of a large male elephant, which had been driven towards the village. The ferocious animal gave chase, and caught him immediately under the height where we were standing, carried him some distance with his trunk, then threw him down and bringing his fore feet together, trod and stamped upon him for a considerable time, till he was dead. Leaving his body for a little while, he again returned as if to make quite sure of his destruction, and kneeling down, crushed and kneaded the body with his fore legs. Then seizing it again with his trunk, he carried it to the edge of the jungle, and threw it among the bushes.

"While this tragedy was going on, my brother and I scrambled down the bank as far as we could, and fired at the furious animal: but we were at too great a distance to be of any service to the unfortunate man, who was crushed almost into a jelly.

"Shortly after this catastrophe, a shot from one of the people broke the left fore leg of this animal, which completely disabled him from running. On this occasion we witnessed a touching instance of affection and sagacity in the elephant. Seeing the danger and distress of her mate, the female before mentioned, (my personal antagonist) regardless of her own danger, quitted her shelter in the bushes, rushed out to his assistance, walked round and round him, chasing away the assailants, and still returning to his side and caressing him. When he attempted to walk she placed her flank under his wounded side and supported him.

"This scene continued nearly half an hour, until the female received a severe wound from Mr C. Mackenzie, which drove her again to the bushes where she speedily sunk exhausted from the loss of blood; and the male soon after received a mortal wound from the same officer.

"Thus ended our elephant hunt, and I need hardly say that what we witnessed on this occasion, of the intrepidity and ferocity of these powerful animals, rendered us more cautious in our dealings for the future."*

It may be observed here, that the bullets with which the elephant is shot, are made of a mixture of tin and lead: for a bullet of pure lead is so flattened by the thick hide of the enormous brute, that it penetrates but a little distance. The elephant is also hunted in various other ways; he is sometimes caught in pitfalls by the barbarous Caffres and Hottentots, who make a delightful feast on his flesh, and who would as easily believe that a fly could be tamed and reduced to exact obedience as this creature. It is said that when an elephant once escapes from a pitfall, no art can entrap him again.

In Asia females are sent into the forests, and ordered to utter a peculiar cry, which attracts the male; he is enticed by them into an inclosure, where persons accustomed to the business, assisted by the females, fasten his legs with cables to the stumps of trees, where he is left till he is exhausted with hunger and vain efforts to escape; after which he becomes docile, and generally allows himself to be tamed in the course of six months.

At other times a great number of people surround those pieces of woods, which are known to abound with these animals, and kindling fires to frighten them, gradually force the whole troop into a great inclosure of piles strongly fixed in the ground. From this place they are one by one driven into a small yard, where they are manacled and tamed at leisure.

When this animal is completely reduced under the command of man, his pleasures and pains seem to be wedded to those of his master. If he becomes an attendant on princes, he endeavors to show himself worthy of his situation, and appears proud of his distinction; the

* Library of Entertaining Knowledge.

golden rings and trinkets with which his tusks and various parts of his body are adorned, when in such a situation, flatter his vanity. But if he is allotted to dishonorable or disagreeable tasks, he repines at his disgrace, and becomes careless of his appearance and deportment.

In the Library of Entertaining Knowledge we are told of a man who was accustomed to treat himself and an elephant which he had in charge, with a glass of spirits in the evening, which the animal regularly expected. The man invariably gave the animal the first glass, till one night he exclaimed, "you have been served first long enough, and it is my turn now." The proud beast was offended, refused the glass when he was denied the precedence, and never more would join his master in his revelries.

The elephant readily learns to obey the commands of his driver, and to perform whatever he is ordered: but though he may be thought to perform many curious actions, yet it is not to these that we are to look for the exhibitions of his ingenuity, as has already been intimated, but to those actions to which he is prompted by his own intelligence. For even the stupid ox learns to distinguish the words of his master with undeviating accuracy, and to perform his orders with the greatest precision.

As the trunk is one of the most important organs of the elephant, he uses it with the greatest ease. If it is wounded in the least, he becomes wild with fears. He dreads an encounter with the lion or tiger; for his proboscis is then in danger, from the claws of these animals. When obliged to protect himself against their attacks, he carefully rolls it up, and defends himself with his tusks.

It is by no means surprising that he should pay so much attention to the safety of this instrument, as without its assistance he would be in the most helpless situation. He is incapable of gathering any food with his mouth (except when he is young from the teat of his mother); as his head, from the shortness of his neck, cannot be lowered to the ground, and indeed can be moved but very little. An elephant that was burned to death in Dublin, was found to have thrust his trunk two feet into a very hard ground, to preserve it to the last.

The elephant prefers a shaded moist country filled

with herbage for his residence; he admires the bank of some majestic river, where he can bathe at his leisure. Bishop Heber has given a beautiful description of the appearance of elephants, while bathing. "At the distance of about half a mile from these desolate places, a sound struck my ear, the most solemn and singular I can conceive, proceeding as it were from the water on which we were riding. It was long, loud, deep and tremendous; something between the bellowing of a bull and the blowing of a whale, or perhaps more like those roaring buoys which are placed at the mouths of some English harbors, to warn ships off of them. 'Oh,' said Abdallah, 'there are elephants bathing.' I looked immediately and saw about twenty of these fine animals, with their heads and trunks just appearing above the water. It was their bellowing which I had heard, and which the water conveyed to us with a finer effect than if we had been on shore."*

The elephant swims deep, sometimes sinking the whole of his body and head under the water; but as long as the tip of his trunk is above the surface, he breathes with the greatest ease.

The elephant walks forward with a stiff and grave progression. His motion is very irksome for the rider, as the hind leg, as we have already stated, has the same number of bones as in man, which are arranged in an analogous manner; so that when he steps, his weight comes down without any spring, as in the horse. In rough broken countries he can be outstripped by many animals; but on an open plain he easily overtakes the swiftest racer.

At particular seasons of the year he becomes vicious and untractable, so that his owners are obliged to keep him confined. It was formerly maintained that this animal did not propagate his species in a state of slavery; but at present it is well known that he does, and that the period of gestation is about twenty months and eighteen days. The African elephant is in general larger than that of Asia; the vertical diameter of the head is

* Library of Entertaining Knowledge.

much less in proportion than the horizontal diameter; and the ears compared to those of the Asiatic species are enormous.

In Asia he is found to the thirtieth degree of north latitude, and has formerly existed in all parts of Africa; though at present he is confined to that part which lies south of the Great Desert.

The elephant is hunted principally for the ivory of his tusks, the annual importation of which into England alone shows that at least three thousand are slaughtered yearly to supply the luxuries of that nation.

An accidental variety of this animal is sometimes found of a color almost white, and is held in such veneration in Siam and other parts of Asia that they pay it divine honors: however, if this people were more honest and humane in their notions, we perhaps might overlook this piece of folly, which the Mohammedans of some of those countries do not so readily, as they are fond of observing the effect which is produced on his godship by slicing off his head.

SCIENTIFIC TRACTS.

VOL. II ....NO. XXIV.

COMETS:

INCLUDING AN ACCOUNT OF THE COMET OF OCTOBER, OF THE PRESENT YEAR, 1832.

THE object of this tract is not to give a scientific dissertation on comets, but to present some general facts connected with the subject, thrown into such a form as may be easily understood by those whose employments prevent the study necessary to obtain such information from scientific works. The comet which is now visible in our horizon, and which will intersect the earth's path in October of the present year, gives to this subject a new interest; and as much excitement has been felt on the approach of this wanderer of the upper deep, and much alarm spread by the reports of the superstitious and timid, that it would strike our globe, it is hoped that this pamphlet may tend to allay all such groundless fears.

Considering the nature of the subject, no branch of human knowledge rests upon a more immovable basis, and susceptible of a more rigid demonstration, than that of Astronomy. The declarations of mathematical Astronomy may be used as among the best established facts of science. The time has been, when to assert that the earth was round and turned on its axis once in twentyfour hours, would subject life to peril; now, the elements of a comet, with its almost inconceivable velocity, and its tail extending through millions of miles, are received as well attested facts. In this advanced state of science, it is deemed unnecessary to adduce the mathe-

matical proofs of what may here be asserted. The scientific scholar will perceive that such evidence is uncalled for, as the facts have long been established, and the general reader may rely with the utmost confidence upon the truth of such assertions. All mathematical demonstrations will therefore be dispensed with.

Comets are distinguished from the other heavenly bodies, by their appearance and motion. The appearance of the planets is globular, and their motion round the sun is nearly in the same plane from west, by south to east. The comets have a variety of forms and their orbits are not confined to any particular part of the heavens, nor do they observe any one general direction, but they approach the sun from every possible direction. The orbits of the planets approach nearly to circles, while those of the comets are very elongated ellipses. A wire hoop will, for example, represent the orbit of a planet. If this same hoop have two opposite sides extended so that it shall be long and narrow, it will then represent the orbit of a comet. The sun is always in one of the foci, or near to one end of the comet's orbit. That part of an orbit nearest to the sun is called the *perihelion;* that part most remote, *aphelion.*

That part, which is usually brighter or more opaque than the other portions of the comet is called the nucleus. This is surrounded by an envelope, which has a cloudy or hairy appearance. These two constitute the body and in many instances the whole of the comet. Most of them, however, are attended by a long train, called the tail; though some are without this appendage, and when seen by the naked eye are not easily distinguished from the planets. Others again have no apparent nucleus, and seem to be only globular masses of vapor.

Nothing is known with certainty of the composition of these bodies. The envelope appears to be nothing more than vapor, becoming more luminous and transparent when approaching the perihelion. As the comets pass between us and the fixed stars, their envelopes and tails are so thin, that stars of very small magnitudes may be seen through them. Some comets having no nucleus, are transparent throughout their whole extent.

The nucleus of a comet appears sometimes opaque and then resembles a planet. Astronomers, however, are not agreed upon this point. Some affirm that the nucleus is always transparent, and that comets are in fact nothing but a mass of vapor, more or less condensed at the centre. By others it is maintained, that the nucleus is sometimes solid and opaque. It seems probable however, that there are three classes of comets; viz: 1. Those which have no nucleus, being transparent throughout their whole extent. 2. Those which have a transparent nucleus; and, 3. Those, having a nucleus which is solid and opaque.

At a distance from the sun, a comet, when viewed through a good telescope, has the appearance of a dense vapor surrounding the nucleus, and sometimes flowing far beyond into the region of space. As the comet approaches the sun, its light becomes more brilliant, till it reaches its perihelion, when its light is more dazzling than that of any other heavenly body, the sun excepted. In this part of its orbit, are seen to be best advantage, the phenomena of this wonderful body, which has from remote antiquity been the object of alarm and terror. When in its perihelion, the tail of the comet is usually increased in length and generally turned from the sun. This is not always the case. Sometimes the tail is considerably curved towards the region to which the comet is tending; and in some instances, it has been observed to form a right angle with a line drawn from the sun through the centre of the comet. The tail of the comet of 1744, formed nearly a quarter of a circle; that of 1689, was curved like a Turkish sabre. Sometimes the same comet has several tails. That of 1744 had, at one time, no less than six, which appeared and disappeared in a few days. The comet of 1823, had, for several days, two tails, one extended towards the sun, and the other in the opposite direction. The observations of philosophers upon comets, have as yet detected nothing of their nature. Tyco Brahe and Appian supposed the tail of the comet to be produced by the rays of the sun, transmitted through the nucleus, which they supposed to be transparent and operated as a lens. Kepler thought

the tail was occasioned by the atmosphere of the comet, driven off by the impulse of the sun's rays. This opinion with some modification was also maintained by Euler.

Sir Isaac Newton conjectured, that the tail of a comet is a thin vapor, rising from the heated nucleus, as smoke ascends from the earth; while Dr Hamilton supposed the tails to be streams of electricity.

"Who shall decide when *doctors* disagree?"

Comets have always been considered by the ignorant and superstitious, as the harbingers of war, pestilence, and famine. Nor has this opinion been, nor is it to this day, confined to the unlearned. The belief was once universal. And when we examine the dimensions and appearances of some of these bodies, we cease to wonder that they produced a universal alarm.

According to the testimony of the early writers, a comet made its appearance in 43 B. C., which could be seen in daylight with the naked eye. This comet made its appearance, just after the death of Cæsar; and by the Romans, was believed to be his metamorphosed soul, armed with fire and vengeance. This comet is again mentioned as appearing in 1106, and then resembling the sun in brightness, being of great size, and having an immense tail.

In A. D. 1402, a comet was seen, so brilliant as to be discerned at noon-day.

In 1456, a large comet made its appearance and will return in November, 1835. This comet spread a wider terror than was ever known before. The belief was very general, among all classes, that the comet would destroy the earth, and that the day of judgment was at hand. At the same time, the Turks extended their victorious arms across the Hellespont and seemed destined to overrun all Europe. This added not a little to the general gloom. Under all these impressions, the people seemed totally regardless of the present, and anxious only for the future. This was at the time when the Romish Church held unbounded sway over the lives, and fortunes, and consciences of men. To prepare the world for its expected doom, Pope Calixtus III. ordered the Ave Maria,

to be repeated three times a day, instead of two. He ordered the church bells to be rung at noon, which was the origin of that practice, so universal in christian churches. To the Ave Maria, the prayer was added; "Lord save us from the Devil, the Turk, and the Comet:" and once each day these three obnoxious personages suffered a regular excommunication.

The Pope and clergy, exhibiting such fear, it is not a matter of wonder, that it became the ruling passion of the multitude. The churches and convents were crowded for confession of sins, and treasures uncounted were poured into the Apostolic Chamber. Daily confession was insisted on; and the believing Catholics, like the Egyptians of old, after they had brought all their money, gave up to the church their cattle, their houses, and their lands, in exchange for the remission of sins.

The comet, after some months of daily cursing and excommunication, began to show signs of retreat, and soon disappeared from those eyes in which he found no favor. Joy and tranquillity soon returned to the faithful subjects of the Pope, but not so with their money and lands. The Pope, who had achieved so signal a victory over the sky monster, had checked the progress of the Turk, and kept, for the present, his Satanic majesty at a safe distance, was not to deprive the church of her just reward in these her jewels, so bright and precious in his estimation. The people became satisfied that their lives and the safety of the world had been cheaply purchased, and the Church of Rome, retaining its unbounded wealth, was enabled so continue that influence over her followers, which she retains in part to this day.

The comet of 1680, would have been still more alarming, than that of 1456, had not science robbed it of its terrors, and history pointed to the signal failure of its predecessor. This comet was of the largest size, and had a tail, of the enormous length of more than *ninetysix millions of miles.* There is then no fiction in the description of the poet;

> "Lo! from the dread immensity of space,
> Returning, with accelerated course,

> The rushing comet to the sun descends;
> And as he sinks below the shading earth,
> With awful train, projecting o'er the heavens,
> The guilty nations tremble."

Is it wonderful, that in an age, darkened by ignorance and superstition, that such messengers should be looked upon as evil omens?

We can easily imagine their appearances, when we are told, that the tail of the comet just alluded to extended from the horizon to the zenith; and that of 1744 had, at one time, six tails, each seven millions of miles long. The comet of 1769 had a tail of more than thirtyeight millions of miles. Add to these, the great velocity with which they move through the region of the solar system, and it certainly needs the aid of philosophy to convince one of his own safety.

The nucleus or solid part of the comet is usually very small.

The comet of	1798,	had a diameter of	26	miles.
That of Dec.	1805	"	29	"
That of	1799	"	373	"
That of	1807	"	537	"
That of	1811	"	2617	"

Many of our adult readers will well remember the beautiful comet of 1811, which was so generally considered, among the superstitious, as the dread harbinger of the war, which was declared in March, 1812. This was one of the most brilliant comets of modern times; though from its great distance from the earth it appeared smaller than it really was. A short description of this comet will assist us in forming an idea of this class of the heavenly bodies.

The nucleus of the comet of 1811 was 2617 miles in diameter. This corresponds nearly to the size of the moon. The envelope, or atmosphere, surrounding the nucleus, was 24,000 miles thick, which is about five hundred times as thick as the atmosphere, which envelopes the earth; making the diameter of the comet, including its envelope 50,617 miles. It had a very luminous tail, which, like those of most other comets,

was variable in its length. Its greatest length was found to be *one hundred millions of miles.* This comet moved in its perihelion with an almost inconceivable velocity, fifteen hundred times greater than that of a ball, bursting from the mouth of a cannon. The conjecture of Dr Halley seems highly probable, that if a body of that size and having such a velocity, should strike our earth, it would instantly reduce this fair fabric to chaos, mingling its elements in one mighty ruin. The comet of 1811 was again seen in the summer of 1812.

About 500 comets have been observed since the Christian era. It has been before remarked, that in their orbits they observe no one direction, like the planets, but approach to and recede from their great centre of attraction, in every possible direction. Nothing can be more sublime or better calculated to fill the mind with profound astonishment, than to contemplate the revolutions of comets, while in that part of their orbits, which comes within the sphere of the telescope. Some seem to come up from the immeasurable depths below the ecliptic, and having doubled heaven's mighty cape, again plunge downward with their fiery trains,

"On the long travel of a thousand years."

Others appear to come down from the zenith of the universe to form their perihelion, and then reascend far beyond the reach of human vision. Others are dashing through the solar system in all possible directions, and apparently without any uninterrupted or uninterrupting path prescribed by Him, who created and sustains all things.

Of 97 comets, whose elements have been calculated by astronomers, 24 passed between the sun and the orbit of Mercury; 33 between the orbits of Mercury and Venus; 21 between the orbits of Venus and the Earth; 15 between the orbits of Earth and Mars; 3 between the orbits of Mars and Ceres; and 1 between the orbits of Ceres and Jupiter. Fortynine of these comets move from west to east, and 48 in the opposite direction.

From all the facts now stated, what inference may be

drawn relative to the influence these bodies may have upon the solar system or upon our globe? Is it possible for a comet to come in contact with the earth or any other planet?

The great principles of mathematical Astronomy, which are found to apply to all the heavenly bodies, would, if space permitted us to adduce them in this treatise, help us to place this part of our subject in such a light as would be conclusive to the minds of our readers. If, however, it can be proved that comets obey the same general laws, which govern and regulate the movements of the planets, it would be, at least, a strong presumption in favor of the belief, that they have, like the other bodies of the solar system, their bounds prescribed, beyond which they cannot go. Of these laws we shall offer but a single example.

One of the great principles of this science was discovered by Kepler, and in honor of him is now called Kepler's law. He ascertained that in all bodies moving round the sun, there was an intimate connexion between their velocities and distances. From these he discovered that a line drawn from the sun to the body moving round it, described or passed once equal areas in equal times. It is only necessary for our present purpose to observe, that this law applies with equal precision to the comets as to the planets.

Our limits in this paper will not permit us to discuss this question in its minute details. Perhaps it would be better to dispose of this important point in a manner which we think our knowledge of the facts, and the common use of language will justify, and say, that *it is impossible for such an event ever to occur.* We say impossible, not forgetting that all things are possible with the Deity; but, judging from all we know of natural cause and effect, and taking into view all the known facts in the case, we repeat, that it is not within the bounds of rational probability, that a comet can strike the earth or any other planet.

If the question were asked, can the waters of the ocean ever overflow and cover the highest mountains of the earth? we should answer, judging this question by the known uniform operation and effect of the great

laws of nature. Such an event is impossible: yet it is beyond doubt, that such an event has occurred. We know of no causes, now in operation, which can render such an event even probable; but, the same power that once unsealed the fountains of the deep still exists, and therefore renders a universal deluge possible.

Mr Whiston, who was successor to Sir Isaac Newton in his mathematical professorship at Cambridge, was of the opinion that the deluge was caused by a previous visit of the comet of 1680. It has been proved, since the elements of this comet were calculated, that it was near the earth, at a time corresponding nearly with the Mosaic account of the deluge. This was sufficient in the opinion of Mr Whiston to justify the belief that the flood was caused by it; but unfortunately for such a belief, there is one stubborn fact to oppose it, not easily disposed of. It has likewise been proved, that at the flood, the comet was no nearer the earth than it was in 1680. Now it is well known, that in 1680 it caused neither flood nor tide, nor had it any perceptible influence whatever upon the earth.

It has likewise been conjectured, that the final conflagration of the globe would be caused by the striking of a comet: and by some of the ancients, it was believed that comets were the places of torment for the wicked, where they were subjected alternately to the intense heat and cold, supposed to be experienced by the comets in their orbits, at one time nearly touching the sun, and then extending far off into the regions of space.

Such may be ingenious theories, but they have no basis of facts to rest upon. They more properly belong to the chimeras of Astrology, than to the heaven-born science of Astronomy.

So far as regards a comet coming in contact with our earth, we surely cannot deny, that the Almighty may not employ this means of destroying the earth, and annihilating, in an instant, all the races of living creatures; but we are again warranted in saying, that there are no traces of evidence that our earth ever has been struck by a comet, and that such an event is, agreeably to the fixed laws of the solar system, beyond the last link in the chain of probabilities.

Is there then no other way in which a comet may affect the earth, than by coming in contact with it? A recent French writer, to whom I am indebted for many of the facts in this paper, observes, that there are three ways in which a comet may, at a distance, act upon the earth; viz. by attraction, by the effect of its light and heat, and by the gaseous matter which composes its envelope or tail, coming in contact and mixing with the earth's atmosphere.

It will be remembered that all bodies attract and are attracted in proportion to the quantity of matter they contain; and that attraction decreases in a certain proportion as the distance increases. It will also be necessary to remember, that by these mutual attractions, the planets are subject to occasional variations from their proper orbits. Thus the earth by the attraction of other planets, is sometimes drawn several thousand miles out of its usual path, in performing its yearly revolution. Comets are known to experience such deviations in a much greater degree. When they come within the solar system, they are attracted and drawn out of their natural course, and often preceptibly retarded in their progress. Some of the comets are so subject to such perturbations, that an exact calculation of their elements is rendered a matter of considerable uncertainty. The effect of the planetary attraction upon a comet is often very considerable; but as yet, no effect of a comet's attraction upon the earth, has been detected.

The attraction of the moon causes the tides of the ocean. The comet of 1811, was about the size of the moon and, consequently, if it contained the same quantity of matter, it ought to have caused similar tides, in proportion to its distance, compared to that of the moon; but no such tides were produced. The comet of 1770 came within 1,456,840 miles of the earth; a shorter distance than has ever been known, between us and any other comet. La Place ascertained that the attraction of the earth increased the length of this comet's revolution more than two days. In this case it might also be expected, that the reaction of the comet on the earth would increase the length of the earth's revolution; yet it is known, that the length of the year 1770 did not

vary one second. It was known that this comet would pass very near to the satellites of Jupiter; and, by some astronomers, it was confidently expected to derange that system of moons, and even to carry some of them off into unknown regions. Not the slightest disturbance, however, was produced. These facts, with many others that might be mentioned, seem to justify the opinions now entertained by astronomers, that comets are bodies of little density, and consequently, possess little power of attraction.

The opinion has been general, that the light and heat of comets very materially affect the temperature of our atmosphere. Experiments of the most delicate nature do not sanction this belief. The light of the comet of 1811 was nearly equal to one-tenth of that of the moon; and the rays of the moon, when most powerfully concentrated upon the bulb of an air-thermometer, produce no visible effect. But a reference to the *average temperatures* of any one place for a number of years, will most satisfactorily settle the point now under consideration. The average temperature is ascertained by thermometers kept in the same place, and consulted several times each day. The following exhibits the average temperature at Paris, expressed in degrees and tenths of the French centigrade thermometer.

Years.	Av. Tem.	No. Comets.	Years.	Av. Tem.	No. Comets.
1803	10°,6	0	1818	11,4	2
1804	11,1	1	1819	11,1	3
1805	9,7	2	1820	9,8	0
1806	12,1	1	1821	11,1	1
1807	10,8	1	1822	12,1	3
1808	10,4	4	1823	10,4	1
1809	10,6	0	1824	11,2	2
1810	10,6	1	1825	11,7	4
1811	12,0	2	1826	11,4	5
1812	9,9	1	1827	10,8	3
1813	10,2	2	1828	11,5	0
1814	9,8	0	1829	9,1	1
1815	10,5	1	1830	10,1	2
1816	9,4	0	1831	11,7	0
1817	10,4	0			

It may readily be observed, by a reference to the foregoing table, whether the presence of comets have any influence upon the temperature of our atmosphere. The year 1805, with two comets, was a colder year than that of 1803, in which no comet appeared. The same is true of 1808, which had four comets. The average temperature of that year was lower than that of 1809, having no comet. The year 1811, was one of the three warmest of 30 years; but the comet of that year did not make its appearance till the close of the year. It continued through nearly all the summer of 1812, notwithstanding that year was one of the six coldest of 30 years. So it will be perceived, that the year 1831, without a comet was warmer than 1826, which had the unusually large number of five. With these facts before us, and they seem quite sufficient to settle this quesion, it is not easy to conceive how it can be proved, that comets effect the temperature of the earth.

The last question attending this part of our subject is, can the tail of a comet pass into the earth's atmosphere, and, by mingling with it, produce pestilence or famine?

Here again we can only speak of probabilities. Comets have always been looked upon as messengers of evil omen, and consequently have borne a bad name with the majority of mankind. Wars and earthquakes, pestilence and famine have been supposed to follow in the train of this long tailed monster; and calamities unnumbered have come down upon man and beast, from his destroying breath. Nothing is easier than to imagine an evil, and, under the excitement of fear, to attribute it to some cause.

The comet of 1811 had a tail of 100 millions of miles in length. Supposing this tail to be composed of particles of ponderable matter, the extreme particles could be but very slightly attracted by the comet; and, while passing through the solar system, these extreme particles might come within the more powerful attraction of the earth, and thus be drawn off and mingle with our atmosphere. The comet, just mentioned, was at one time, within 114 millions of miles of the earth. Had its tail been directed towards us, its extremity would have been

within about fourteen millions of miles of us. In such a case, it is probable that the attraction of the earth would have overcome that of the comet, for the extreme particles of its tail, and consequently, a part of it would have been left behind and ultimately drawn into the atmosphere of our globe. From the length of some of the tails of comets, and the slight degree of attraction necessarily existing in such bodies, as are *supposed* to compose them, they could seldom pass through the solar system, without subjecting themselves to the loss of their bright appendages. From these *assumed* premises of the *nature* of a comet's tail, the conclusion follows, of course, that the earth and other planets may frequently draw off and appropriate to themselves, a part of such a tail. It would then be contended, that the introduction of such gaseous matter might change or destroy the vital principle of our atmosphere, and occasion the death of men and animals. Here then would be found one cause of those pestilential scourges, which are said to follow when some great comet has appeared.

But we deny the premises, and consequently the conclusions. To suppose that the tail of a comet may be attracted by the earth presupposes that the tail is composed of vapory particles of ponderable matter. Now this is by no means certain. And here we might rest the argument, till the assumed proposition be proved. As yet, there is no evidence in its favor: it rests wholly upon supposition. But allowing such an event to occur; our atmosphere would be rendered impure, only in case the substance of the comet's tail was different from that which surrounds the earth. The comet's tail may be different from our atmosphere, or it may not; which, we will not attempt to decide: we only say, that in absence of all proof on this point, there is no sufficient reason to believe, that such an occurrence, as the mingling of a comet's tail with our atmosphere, ever has taken place or in the natural course of events, ever will.

Nothing in the history of the past will sanction the opinion, entertained by some writers on this subject. Among the effects of comets, they have been supposed to shed their baleful influence on the earth in cold and

hot seasons, tempests, hurricanes, earthquakes, volcanic eruptions, violent hail-storms, great falls of snow and rain, droughts, thick fog, famines, rich and abundant harvests, numerous insects, plague, dysentery, cholera, diseases among animals, and many other such evils. With how much justness these calamities have been charged to comets, we leave every one to judge. We think it sufficient to observe, that the number of comets, given in the foregoing table, compared with the famines, pestilence, &c, of the same time, does not sustain the opinion 'that the appearance of comets has always been followed by great calamities.' The history of comets and the history of diseases no more prove that one is the cause and the other the effect, than that a presidential election causes the northern lights, because they sometimes happen together.

Divested of their imaginary terrors, and viewed as forming a part of the solar system, comets are objects of no ordinary interest. Whether we contemplate their forms or their revolutions, they alike fill us with astonishment. As we look upward into the clear sky of evening and behold among the countless millions of heavenly bodies, one, blazing with its long train of light, and rushing onward towards the centre of our system, we insensibly shrink back within ourselves, as if in the presence of a spiritual being; and when, with the eyes of astronomy, we follow it through its perihelion, and trace it far off beyond the utmost verge of the solar system, till it is lost in the infinity of space, not to return for centuries, we are deeply impressed with a sense of that power, which could create and set in motion such bodies. Their mysterious natures and the unknown purpose of their creation, but add to the emotions with which we contemplate them, and our feelings and our reason pronounce them the work of Omnipotence We can discover in everything marks of power, but nowhere are its manifestations so grand and sublime as in the countless suns and systems of worlds which fill the universe. Nor is power alone the only attribute there displayed. Infinite Wisdom formed and still regulates the whole. It is not then becoming rational creatures to pronounce harshly

against what he has created, or to doubt that they are all bound by immutable laws, which they silently obey, to accomplish the great design of Him,

> Who gilds an insect's wing,
> And guides the comet in its wild career.

It now only remains to give some account of the comet of the present year, 1832. The present is not the first appearance of this comet. It was first discovered in 1772, and was again observed in 1805, and also in 1826. It was not until the last named period, that its elements were calculated, when it was found to have a periodical revolution of six years and three quarters. This comet *has no tail*; and, according to the observations of M. Olbers, of Bremen, its diameter, including its envelope, is about 42,280 miles. In performing its present revolution, it will come within the orbit of the earth; that is, within the circle described by the earth, in its annual path round the sun. A plane extending from one side to the other of this circle, is called the plane of the earth's orbit. The comet of this year will cross this plane, according to the recent calculations of Mr Damoiseau, *on the 29th of October before midnight.*

To ascertain the point of this intersection was an object of much importance, to see whether the fears, that the comet would strike the earth, were well founded.

The danger, if there be any, will occur at the time the comet crosses the ecliptic: for as the earth never deviates from this plane, a collision could take place nowhere else. If the calculations, then be correct, the comet can strike the earth at no other time, during its present revolution, than on the 29th of October. The distance of the earth at the time the comet crosses the plane of the ecliptic, and the point of intersection, will enable us to settle this important question.

The facts then in the case, as appears from the most minute calculations, are, that the comet will pass through the plane of the ecliptic just within our orbit, and at a distance from it of only 18,500 miles. It has already been remarked, that the diameter of the comet, including its envelope, is 42,280 miles; consequently a part of the

comet's envelope will be included in the orbit of the earth. It is then evident that if the earth were in that part of her orbit, at the same time with the comet, our atmosphere would mingle with the atmosphere of the comet, or perhaps the two bodies would come in contact.

The position of the earth on the 29th of October, must now settle the question.

The earth in its revolution, moves at the rate of about 68,000 miles per hour; and with this velocity, it will be moving, on the 29th of October *towards* the point, where the comet will touch our orbit; but the earth will not arrive at that point till *the 30th of November, when the comet will have been gone thirtytwo days* in its rapid flight round the sun. We therefore shall be at a safe distance behind it; and at no time, during the year 1832, will this comet come within *fortyeight millions of miles of the earth.* There is then no reason for the alarm, which has been felt on this subject. Science declares, that in no way can the comet of this year come in contact with our earth and in this declaration the public may repose unwavering confidence.

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